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Digital Collage-Access to inspiration: The use of multimedia as a catalyst for creative thought

Frederick George Still

DIGITAL COLLAGE—ACCESS TO INSPIRATION: THE USE OF MULTIMEDIA AS A CATALYST FOR CREATIVE THOUGHT

A Project

Presented to the

Faculty of

California State University,

San Bernardino

In Partial Fulfillment

of the Requirements for the Degree

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in

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Instructional Technology

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ABSTRACT

This paper takes the position that creativity can be enhanced by multimedia. Computer software was designed and a study was conducted to measure that proposition. The author used participant self-analysis as a means to gather data on creativity enhancement holding to the presupposition that people can tell when they are creative and when their creativity is inhibited.

The results of the study supported the belief that multimedia and the software designed for that purpose was able to enhance creativity. The study also generated four factors that inhibited creativity and three factors that enhanced it. Two recommendations were made for further research. One to investigate the cause of variations in creativity emphasizing the possibility of multiple creativity types. The other to investigate the feasibility of using emotion as an indicator of creativity.

ACKNOWLEDGMENTS

Many thanks go to artists Rodney Matthews and Jonathon Bowser, for permission to use their fabulous artwork. The work of Rodney Matthews can be seen on his website at http://www.rodneymatthews.com. The work of Jonathon Bowser can be seen at http://www.jonathonart.com. A special thanks goes to my son Kyle. Not only for the use of his incredible artwork, but also for allowing me to invade his studio and put words in his mouth during the taping of the video segment of his gallery page.

To my daughter and son-in-law, Carrie Anne and Rob, thank you for the hours of help editing when you could have been doing something fun.

Thank you to my friends and colleagues spread throughout the United States, who took the time to review and comment on Digital Collage.

To those who spent grueling hours, after a long workday, taking part in the study and filling out the endless paper work, many, many thanks.

Most of all thank you to my family who, for too long and without complaint, has endured the phrase, "When the project is over we will..."

DEDICATION

This work is dedicated to the Lord Jesus Christ, the ultimate source of all creativity and to my wife, Mary Sue, and our ten children—the fulfillment of the dreams that really matter.

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CHAPTER ONE

OVERVIEW

Introduction

Creativity has been the subject of analysis and clinical studies for over eighty years. Yet there is consensus among the experts regarding only its most basic characteristics. No one really knows what creativity is, but everyone wants more of it. Business, education, science and the arts all recognize its value and have sponsored research projects in the hope of finding ways to harness and enhance it.

Creativity is examined in the following document. Two fundamental questions are addressed. What are the mechanics of creativity and can it be enhanced by multimedia? These issues are examined first in a review of current literature, and then through a study measuring changes in participant creativity while under the influence of multimedia software designed by the author called Digital Collage.

Statement of the Problem

We have all experienced mental melt down. That sensation that constricts us when we stand immobilized

before some mind numbing obstacle. With desperation we attempt to conjure creativity—but how is it summoned? What are the factors that produce creativity and in what environments will it grow? Learning the factors that stimulate creativity is a universal need.

When faced with a dilemma we think about the dilemma. We seldom consider about *how* to think about the dilemma. Each set of circumstances that requires inspiration suggests the possibility of different categories of creativity. "How can we enhance creativity and identify the factors involved?" is the question this research will address.

Goals

The goals of this study are as follows:

1. To gain insight into the nature of creativity through the review of current literature and dynamic observation
2. To measure the capacity of multimedia to enhance creativity with software designed for that purpose.
3. To identify factors capable of enhancing or inhibiting creativity

Significance of the Project

The enhancement of creativity is a universal benefit. Creativity training could become an effective part of our educational system at every level if creativity can be effectively enhanced by multimedia and the enhancing or inhibiting factors can be clearly defined. Suggestions for further research that grows out of this study could lead to the development of valuable research tools. Knowledge of variations in creativity could lead to greater precision in tailoring training software to the creativity profile of a student.

Limitations

This project does not pretend to be comprehensive research into the nature of inspiration or the creative act. There is no statistical analysis to validate any observations that may be made. Because this paper attempts to document the creative processes in a small group of individuals, the observations may not be representative of a larger sample. Likewise, those chosen to participate in the study were a convenience sampling and data they produced was a product of untrained self-analysis. The intent of this paper is exploratory.

All conclusions that are drawn from this project should be validated through further research.

Definition of Terms

Creativity - Researchers in general agree on the following four criteria as a broad definition of a creative activity. 1. The activity must have a product. 2. The product must be novel. 3. The process must be unique. 4. The results of the activity must have value. For our purposes, as long as the process includes cognition, any combination of at least three of these criteria will constitute creativity. Furthermore, novelty, uniqueness and value will be judged from the performer's point of view. For example if a product is to meet the novelty of value criteria it need only be novel or valuable to its creator.

Inspiration - Arousal of the mind to special unusual activity used as a synonym for creativity.

Ideation - A term describing the process of forming ideas

Digital Collage - The name given to the multimedia application created for this project.

Multimedia - Transmission that combines media of communication (text and graphics and sound etc.)

Lingo - A programming language used exclusively in Macromedia Director to give the user control over the programs functionality.

CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

The title of this paper is "Access to Inspiration: The use of multimedia as a catalyst for creative thought." The implications are that creativity can be generated or influenced by some external stimulus; and that computers can create such a stimulus through multimedia. However, since neither of these implications is universally accepted, it would be beneficial to examine contemporary thinking with regard to nature of creativity as well as the use of computer for the enhancement of creativity.

Ignorance and uncertainty is rampant in the area of creativity and the literature does not provide a clear consensus of expert opinion for either topic. There are those who claim that creativity is a function of ones genetic make up and can not be significantly altered through external means. Others will criticize the use of computers for creativity enhancement as overrated or unproven. Nevertheless, there is enough agreement and support among the researchers to dispel some ambiguity

and to provide guidelines for both practical application and further study.

The Principles of Creativity

What Constitutes Creativity?

Harris (1998) defines creativity as an ability, an attitude, and a process:

> An Ability...to imagine or invent something new...An Attitude...to accept change and newness, a willingness to play with ideas and possibilities... A Process...to improve ideas and solutions by making gradual alteration and refinements. (p. 2)

Harnad (2002, p. 2) isolates "originality," "value," and "unexpectedness" as the three criteria required to identify any form of creativity. He suggests that creativity is an allusive cognitive trait favoring some people over others and occurs as a transient state of being that people can enter into but can not sustain. The editors of "Creativity and Madness" (Panter et al., 1995, as cited in Buchanan, 2001, p.2) noted that in addition to "seeing things in a new way" and "the ability to bring something new into existence" creativity is "a

constructive outlet for painful feelings and confused states of being." Freud, after careful analysis, concluded that creativity is the product of a "neurotic day-dream" (Glover, chap. 1).

Confusing and vague generalizations regarding creativity abound, and the task of developing a comprehensive definition is monumental. There are, however, many descriptions of creative behavior that are recurrent in literature. Appellations that denote uniqueness and novelty are common. Margaret Boden includes novelty in her 1994 definition of creativity but also adds the quality of value. She says that creativity is the act of generating ideas that are novel and valuable in a wide scope of endeavors including art, music, design, science, problem solving, etc (Buchanan, 2001).

Newell, Shaw, and Simons (1958, as cited in Buchanan, 2001) identified the definitive characteristics of creativity as novelty, unconventionality and persistence in the face of difficulty. Because their pioneering work in Artificial Intelligence required a manageable definition of creativity, they limited themselves to creativity as it relates to problem

solving. They divided problem solving into four categories—product, process, person, and problem. Then they defined the criteria for creativity in each category as seen in Table 1.

Table 1. Characteristics of Creativity

Category	*Criteria for creativity*	*Description*
Product	Novelty	The degree of novelty and value attributed to the product of the thinking.
Process	Unconvention-ality	The amount of unconventionality employed it the process.
Person	Persistence	The level of persistence and motivation found in the person responsible for the problem solving.
Problem	Difficulty	The degree of difficulty or vagueness of the initial problem.

Most people have their own subjective sense of what should be considered creative. This innate subjectivity is one of the factors that make the term so difficult to define. Boden suggests that general approval must exist for behavior to be considered creative (Buchanan, 2001). A social distinction maybe the only thing that separates the crackpot from the genius. Hence the concept of value

or usefulness to society looms in importance. In a survey conducted by Sternberg (1988, as cited in Buchanan, 2001) six major characteristics were found to be associated with creative behavior:

> (1) lack of conventionality; (2) the recognition of similarities and differences and the making of connections; (3) appreciation for and ability to write or draw or compose music; (4) flexibility to change directions; (5) willingness to question norms and assumptions; and (6) motivation and energy. (p. 2)

Knowledge is a factor which many analysts consider essential to creativity. Sternberge (1988b, p. 137, as cited in Buchannan, 2001) said "It is impossible to have novel ideas about something if you know nothing about it." Johnson-Laird (1988, as cited in Buchannan, 2001) claimed, "Geniuses need to know more, and to have this knowledge in a form that can control the generation of new ideas." However, if knowledge becomes a barrier against the unfamiliar or extraordinary then creativity will be inhibited. Moses Farmer, felt that Alexander Graham Bell's ignorance of electricity was a complement

his creativity. He said, "If Bell had known anything about electricity he would never have invented the telephone" (Watson, 1913, as cited in Buchanan, 2001).

Models of Creativity

Clearly defining creativity is an exercise in diversification. It bears resemblance to blind men attempting to describe an elephant. Some researchers grab hold of the tail, some run statistical analyses on the trunk, and some set criteria for defining the ear. Buchanan (2001) notes, "There is no consensus, just considerable ambiguity, about what we call creative behavior or what is involved in this behavior." This ambiguity has driven some researchers to forsake a global study of creativity and focus their attention on isolated factors, or what they consider key elements, of the creative process. Just as the blind men were unable to see the whole elephant, some analysts acknowledge that researchers can not see the essential whole of creativity and are reduced to analyzing only the discernable parts (Johar, Holbrook and Stern 2001). Other analysts such Wertheimer (1945, as cited in Plsek, 1996) and Vinacke (1953, as cited in Plsek, 1996) contend that the whole of creativity is more than the sum of its discernable parts.

They claim that creative thought cannot be segmented, but rather is dependent on integration and flow within the entire thinking process and as such does cannot be reduced to the simple steps of a model (Plsek, 1996).

Researchers have, nevertheless, identified and organized several sequential mental disciplines that frequently result in creative acts. These functional models, while often representing opposing theoretical views, are remarkable in their similarities. Torrance (1988, as cited in Plsek, 1996) credits The Wallas Model for the Process of Creativity (Wallas, 1926, as cited in Plsek, 1996) as the source of most of these similarities. He claimed that most creative thinking training programs are built on the foundation of Wallas' model. Plsek (1996) concurs, stating that the theory behind Wallas' model "...is reflected to varying degrees in other models of creativity." The model suggests that creativity moves through four phases: preparation, incubation, illumination and verification. In the preparation stage the issue is observed, defined and studied. Incubation follows preparation in which the issue is laid aside for a time. After the dormant period, illumination takes place and a new idea emerges. The idea is then verified

and the creative process is complete. Plsek (1996) points out that half of Wallas' model, preparation and verification, involves active thinking while the other half, incubation and illumination are non directed processes operating within the subconscious.

Barron's (1988, as cited in Plsek, 1996) Psychic Creation Model appears to differ from Wallas' Model only in terminology. He defines his four phases ontogenetically. Phase 1 is "Conception (in a prepared mind)." Phase 2 is "Gestation (time, intricately coordinated)." Phase 3 is "Parturition (suffering to be born, emergence to light)." Phase 4 is "Bringing up the baby (further period of development)." Barron, like Wallas, sees creativity being mysteriously born in the subconscious beyond the reach of conscious control.

The prevailing ideas ascribe greater control over creativity to analytical processes and mental self-direction. Nevertheless, evidence of Wallas' influence is still abundant in these models. In most cases any additional steps that may be added can still be categorized within the four steps that Wallas originally purposed. For example the first four steps of Osborn's Seven-Step Model for Creative Thinking fit neatly into

preparation, phase 1 of Wallas' model. Osborn's seven steps are:

(1) Orientation: pointing up the problem.

(2) Preparation: gathering pertinent data.

(3) Analysis: breaking down the relevant material.

(4) Ideation: piling up alternatives by way of ideas.

(5) Incubation: letting up, to invite illumination.

(6) Synthesis: putting the pieces together.

(7) Evaluation: judging the resulting ideas (Osborn, 1953, as cited in Plsek, 1996).

Prior to Osborn, Rossman (1931, as cited in Plsek, 1996) had also expanded Wallas' model from four to seven steps. Rossman's Creativity Model, synthesized from a survey of 710 inventors replaces the incubation period with higher level analytical processes. Rossman's seven steps are:

(1) Observation of a need or difficulty

(2) Analysis of the need

(3) A survey of all available information

(4) A formulation of all objective solutions

(5) A critical analysis of these solutions for their advantages and disadvantages

(6) The birth of the new idea—the invention

(7) Experimentation to test out the most promising solution and the selection and perfection of the final embodiment (Rossman, 1931, as cited in Plsek, 1996).

More recently seminars conducted by the Creative Education Foundation of Buffalo, NY, have introduced thousands of people to CPS, creative problem solving, a six-step model for directing and analyzing creativity. The steps are:

(1) objective finding,

(2) fact finding,

(3) problem finding,

(4) idea finding,

(5) solution finding,

(6) acceptance finding. (Isaksen and Trefflinger, 1985; Parnes, 1992, as cited in Plsek, 1996)

Koberg and Bagnall (1981, as cited in Plsek, 1996) introduces proper mental attitude into the first step of their Universal Traveler Model. Plsek (1996) concurs, citing Weisberg (1993), Wallace and Gruber (1992), Gardener (1994) and Ghiselin (1952) as researchers who found that "focusing and caring deeply" is a common denominator within the character of great creators

(Plsek, 1996). Koberg and Bagnell arrange creativity into the following seven-step model:

(1) Accept the situation (as a challenge)

(2) Analyze to discover the "world of the problem")

(3) Define (the main issues and goals)

(4) Ideate (to generate options)

(5) Select to choose among options)

(6) Implement (to give physical form to the idea)

(7) Evaluate (to review and plan again) (Koberg and Bagnall 1981, as cited in Plsek, 1996)

Occasionally, the generation of new ideas and concepts occurs at beginning of a model. Concepts reminiscent of Wallas' illumination phase initiate Robert Fritz' (1991, as cited in Plsek, 1996) Process for Creation. He lists "Conception" and "Vision" as the first two steps in his eight-step model:

(1) Conception

(2) Vision

(3) Current reality

(4) Take action

(5) Adjust, learn, evaluate, adjust

(6) Building momentum

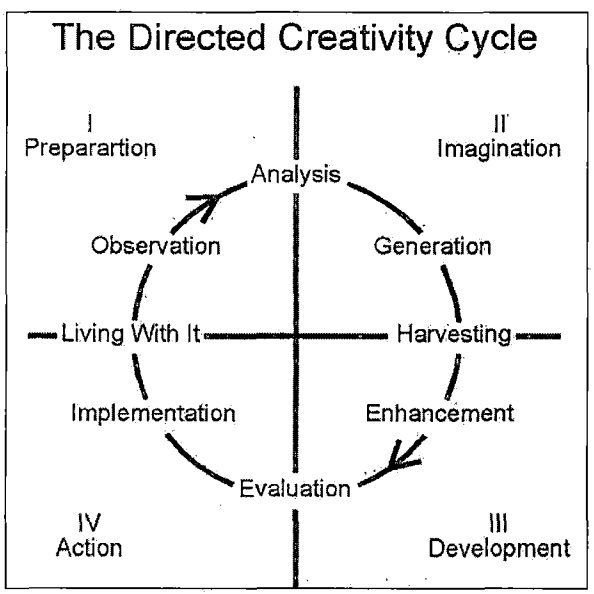
(7) Completion

(8) Living with your creation

Fitz holds that the creative process is cyclical, hence, the last phase, "Living with your creation," is preparatory to the next generation of creativity.

The cyclical nature of the creative process is outlined in a model that Plsek (1996) refers to as the Directed Creativity Cycle. Diagram 1, below, illustrates the flow of directed thinking that Plsek has synthesized from the previous 80 years of cognitive research.

Diagram 1. The Directed Creativity Cycle



Plsek explains what he means by "Directed Creativity":

> We make purposeful mental movements to avoid the pitfalls associated with our cognitive

> mechanisms at each step of the process of searching for novel and useful ideas. (Plsek, 1996)

The diagram shows that preparation for creativity begins with focused observation, shown in quadrant I. It moves through the thoughtful analysis of these observations into the imagination, quadrant II. Concepts, derived from the analysis phase, are associated with each other and stored in memory. Novel ideas are generated as our thoughts, driven by specific needs, sift through our memory bank of associated concepts. Attractive ideas are harvested and enhanced in the development quadrant of the creative cycle. After sufficient refinement or embellishment the candidates for creativity are subjected to practical evaluation. As Plsek points out creative thoughts "have no value until we put in the work to implement them." Thus, if they pass practical evaluation, they enter the implementation phase in the action quadrant of the cycle. Once implementation is complete a tangible product of our creativity is introduced into the environment. We then begin living with the resultant changes which initiates a new set of focused observations thus continuing the cycle of directed creativity.

In each of the preceding models, the researchers reported that the generation of creativity was to some extent controlled or at least influenced by conscious mental behaviors. These researchers have made valuable contributions in cataloging some of these behaviors. By treating creativity as a sealed black box, and dealing only with external influences, they have identified certain mental conditions that enhance or inhibit the process. However, they offer no explanations as to how creativity is generated.

Internal Process of Creativity

The internal mechanisms that govern the inception of creativity remain clouded in conjecture, philosophy and debate. Programming creativity into a computer is such an ideological challenge that some researchers are hesitant to even use the term with regard to their work. For example, Harold Cohen, designer of AARON, an art program capable of independently producing original artwork, refers to computer simulated creativity as "behavior X" (Cohan, 1999).

Models that grow in this rarified air grapple with the every essence of thought. One of the earliest to postulate the genesis of creativity was William James.

His "chance configuration theory," first proposed in the 1880's, leans heavily on the Darwinian principles of random variation and natural selection. It is illustrated in the following three-step model: (1) A chance event occurs and random variations of ideas and concepts are produced in the subconscious. (2) The ideas and concepts emerge from the subconscious and are scrutinized for usefulness by natural selection. (3) The surviving ideas and concepts are preserved and reproduced in concrete product form (Plsek, 1996). Variations this theory are still popular today among those who claim that the creative thought is an uncontrollable function of the subconscious mind (Campbell, 1960; Simonton, 1988, as cited in Plsek, 1996).

In the field artificial intelligence mechanistic definitions are crucial if AI scientists are to program computers to "think" creatively. All of the AI programs that lay claim to "creativity" do so only within clearly defined boundaries. If the criteria for creativity can be identified then programs can be written to satisfy the criteria. Marvin Minsky asserts that a computer can solve any problem by trial and error as long as it has a means to identify the solution (Buchanan, 2001). The

Encyclopedia of the Philosophy of Mind states that "if creativity is a human process that cannot be described mechanistically, then human minds cannot be symbol-manipulation machines" (Buchanan, 2001). Because of the ability to create controlled environments for testing, AI would seem well suited to explore the mechanistic characteristics of creativity. However, the mystery of creativity is not necessarily solved by testing and analyzing programmed behavior. Cohan recognized that the very necessity of programming introduces a catch 22 into the dilemma. He points out that, "... the criterion for behavior X is satisfied only if it can notice something that wasn't included [in the programming]" (Cohan, 1999, p. 13). In other words, to be creative a program must exhibit behavior for which it was never programmed, and do so in such a way that the product of the original programming is improved.

While programming alone may not be able to reveal the essence of creativity, the AI programmer, by the nature of his task, is well equipped to address criteria and/or the possible processes involved. Cohan's criteria for behavior X, his term for creativity, is that it manifests itself in activity which contains the capacity

for self-modification and includes the following essential elements:

1. Emergence—something tangible that rises out of the activity. Emergence can include anything from the concrete to the abstract, from products to thoughts.
2. Awareness—some conscious or unconscious method of identifying and gaining access to what has emerged.
3. Motivation—the willingness, or capacity, to act on the emergence.
4. Knowledge—the absence of innocence and ignorance.

While not commenting on the mechanisms of human creativity Cohan seems to agree with James and others that much of the creative process is implemented on the subconscious level. In describing his own creative process as a painter he writes:

> Colouring for me has always involved a lot of sitting and staring...in the main not consciously deciding what to do next....for the most part I don't know what causes me eventually to stop staring and get to work.

> I...squeeze some...paint from...two or three tubes, mix them up, and recognize that the result is the colour I want. Evidently my non-conscious has been pretty busy while I've been staring at the painting; it had not only provided the colour that I want, but also the program for generating it. (Cohan, 1999, p. 10)

Cohan suggests that the creative process includes a period of non-conscious deliberation upon a body of stored knowledge. After deliberation, both the creative product, and the methodology to achieve that product, is delivered to the conscious mind. Furthermore, he postulates the possibility that knowledge also can be acquired and stored non-consciously (Cohan, 1999). The implication is that the creative function may have knowledge at its disposal that the individual would not expect to possess and furthermore, that this knowledge is accessed during periods of non-thought (Walla's "incubation phase").

Knowledge is crucial to creativity. Most researchers agree with Sternberg (1988, as cited in Buchanan 2001), "It is impossible to have novel ideas about something if one knows nothing about it." Both Weisberg (1999, cited

Buchanan 2001) and Newell, Shaw, and Simon (1953, as cited in Buchanan 2001) concur that "[creative] problem solving...makes essential use of background knowledge in the process." However, in the arena of knowledge Cohan's catch 22, the need for a program to perform beyond the scope its programming, becomes a major roadblock in the quest to simulate creativity. Knowledge, as it relates to creativity, is more than stored data or mere information. It is the capacity to apply information appropriately and understand its significance. Kuhn (1970) underscores the difference between knowledge and information with the following illustration:

> A child might have written $e=mc^2$, for example. Without the background knowledge that puts the formula into context and suggests why it is important, it is more an exercise in penmanship than in physics. (Kuhn, 1970, as cited in Buchanan 2001)

The ability to identify significance beyond the boundaries of the program is one of the main factors that has separated human creativity from even the most advanced forms of artificial intelligence.

According to Buchanan (2001), AI scientists as well as psychologists and cognitive scientists tend to group internal models of creativity into four categories: combinatorial, heuristic search, transformational and layered search. These models suggest variations in logical thought processes that are conceivably employed during the genesis of a creative thought. Combinatorial models involve the continual recombining of data, testing each iteration until a creative product emerges. Heuristic search models suggest that data combinations are sifted through various sets of guidelines, or context sensitive constraints, to generate creativity. Transformational models postulate that patterns that function in one context are transferred and reformed to appropriate parameters in another context. The layered search model envisions a sequence of mental searches beginning at a broad metalevel. The search is then successively narrowed or biased as the data is scanned in each new layer of thought. Although the mechanisms of creativity remain unproven and may as yet be undiscovered, it can be argued that numerous kinds of searches, transformations, and guided re-combinations of available data may be among the processes that contribute

to it. Thus, the various techniques used by the AI scientist to simulate intelligence become useful patterns with which to explore the internal mechanics of creativity.

Even if creativity can be described mechanistically there are those who suggest, contrary to the previously quoted implications in the Encyclopedia of the Philosophy of Mind, that the human mind is more than just a "symbol-manipulation machine." Ben Goertzel (1996), in his book, From Complexity to Creativity, describes the mind as a complex organization of unified hierarchical and diversified heterarchical networks. Creativity is a sub-component of personality. He contends that, "No creative person completely understands what they do when they create. And no two individuals' incomplete accounts of creative process would be the same" (Goertzel, 1996, chap. 14.1).

Goertzel (1996, chap. 14) theorizes that within the human personality is a "creative subself" that generates new realities from abstract forms and structures. The creative subself dynamically reads and organizes the input from a complex system of interconnected neuro networks. Other subselves, more subject to constraints

and environmental inhibitors, balance the product with appropriateness and determines relative value. While it is possible to describe the creative subself and its associative processes mechanistically, Goetzell theory enters into the supernatural by suggesting that inspiration is patterns that extend to the creative subself from the realm of the transcendental (1996, chap. 14.5). While Goetzell is quite candid to factor in religious philosophy into his theories on creative thought, few researchers will go so far as to openly suggest that creativity has a spiritual component. However, it is interesting to note that nearly all of them make allowances for a spontaneous event known to us only by such indefinable terms as illumination, inspiration, ideation and other such enigmatic descriptors.

Enhancement of Creativity

Dating back to the late 1960's there have been literally hundreds of studies addressing the belief that creative output can be enhanced (Amabile et al., 1996). Amabile (1996, p. 258) reports that "...creativity-training programs continue to increase in

popularity" and that for some there is research to support their claim of enhancing at least some aspect of creativity. Osborn-Parnes Creative Problem Solving program (Parnes, 1967), the Purdue Creativity Training Program (Feldhusen, Treffinger, & Bahlke, 1970), the Productive Thinking Program (Covington, Crutchfield, Davies, & Olton, 1972) were all shown in a metanalysis by Rose and Lin (1984, as cited in Amabile et al., 1996) to improve creativity scores. Many activities have also been shown to enhance creativity. Amabile (1996) lists the following:

> Hypnosis (Raikov, 1992); humor (Ziv, 1988); relaxation/isolation environments (such as flotation isolation) (Forgays & Forgays, 1992; Suedfeld, Metcalfe, & Bluck, 1987); long-term and short-term exercise programs (Gondola, 1986); music (Burns, 1988); [the used of] alcoholic beverages (Brunke & Gilbert, 1992); and divergent methods for participating in everyday activities (Cropley, 1990). (Amabile et al., 1996, p. 258)

Much of the research into the enhancement of creativity comes from the area of business, where

creatively solved problems often mean the difference between profit and loss. Thierauf (1999) lists five tools that increase creativity and are useful in problem solving: (1) creative process, (2) brainstorming, (3) synectics, (4) accurate problem definition, and (5) idea generators.

Creative process, which has been previously discussed, specifically refers to the fundamental model set forth by Wallas (1929, as cited in Thierauf, 1999; Buchanan, 2001): (1) preparation, (2) incubation, (3) illumination, and (4) verification. The assumption is that creativity increases when decision-makers organize their planning around the four stages of the creative process.

Brainstorming, used widely in both business and education, increases creative output when operating under four rules suggested by its founder Alex F. Osborn:

> (1) Judgment is withheld; ideas may be criticized and evaluated later. (2) Wild ideas are encouraged; ideas are easier to modify than to originate. (3) Numerous ideas are desired; more ideas increase the possibility of obtaining an excellent idea. (4) The

> participants are encouraged to utilize the ideas of others to develop additional ideas. (Thierauf, 1999, p. 45)

Synectics is built upon the idea that disrupting ordinary patterns of perception to identify new associations stimulates creativity. Thus the two steps of the synectics process are "(1) making the strange familiar and (2) making the familiar strange" (Thierauf, 1999, p. 45). Assuming that creativity can be both defined and taught, the purpose of a synectic team is to increase the quality of creative output. The process begins with a thorough analysis of the problem and its ramification. Then through a series of perception altering techniques such as inverting, transposing, and distorting the team re-examines the issue in the light of new perspectives (Thierauf, 1999).

Accurate problem definition is critical to resolving issues that can jeopardize business. According to Thierauf (1999), it can be arrived at through the use of "cause and effect" diagrams. By circling problems, symptoms and related problems and linking them with arrows, fundamental root causes appear. Circled problems

having only arrows extending from them are creatively isolated and defined as the root cause of other problems.

Idea generators are computer programs designed to stimulate decision-makers' creativity and help them avoid fixating on ideas that revolve around a central theme. These will be alluded to in more detail in the following section devoted to computer enhanced creativity.

Computer Enhanced Creativity

If creative output can be inhibited then it stands to reason that it can be enhanced: if not by other means, then at least by removing the inhibitors. Researchers have identified a number of factors that have been shown to stifle creativity. Some of these inhibitors have been identified while researching the idea generating capacity of brainstorming.

Brainstorming has been found effective in stimulating large numbers of high quality ideas by practitioners such as Grossman, Rodgers, and Moore (1989, as cited in Paulus, Larey, Putman, Leggett & Roland, 1996). However, Amabile, Goldfarb, and Brackfield, (1990, as cited in Sosik, 1998) point out that the fear of evaluation in face to face sessions reduces idea output. Electronic or computer based brainstorming (EBS)

overcomes this inhibitor by allowing participants to submit ideas anonymously. EBS allows comments from group members to be submitted simultaneously; thus avoiding production blocking that Diehl and Stroebe (1987, as cited in Sosik, 1998) observed in traditional brainstorming sessions. According to a number of researchers (Dennis & Gallupe, 1993; Gallupe, Bastianutti, & Cooper , 1991; Valacich et al., 1994, as cited in Sosik, 1998) benefits which include the removing of creativity inhibitors enable EBS groups generate more ideas than face-to-face brainstorming groups(Sosik, 1998).

Dissenters may argue that the studies cited above show increased productivity, not enhanced creativity. Waiting for each brainstorming group member to share their ideas would obviously produce fewer ideas than all members submitting their ideas simultaneously. There is, however, evidence to show that EBS may have individual effects benefits beyond increasing group production.

Simonton (1999, p. 315) notes "creative individuals are a little bit off-beat... they do not feel the inhibiting necessity of forcing their crazy hunches to conform to social and disciplinary conventions."

Conformity inhibits individual creativity and the social dynamics of face to face brainstorming can generate pressure to conform. Participants can experience evaluation apprehension during idea generation. This inhibitor is reduced in EBS sessions by allowing for anonymous idea input (Amabile, Goldfarb, & Brackfield, 1990, as cited in Sosik, 1998). Verbalization of ideas which removes anonymity and increases social anxiety was found to inhibit idea output during EBS sessions by 16% and in non-EBS sessions by 50% (Paulus, Larey, Putman, Leggett & Roland, 1996).

Socialization in the form of competition has a positive impact on creativity as long as opportunity to excel is provided and there is no pressure to conform caused by verbalization. Paulus and Dzindolet (Paulus, et al, 1996) report the following:

> The provision of social comparison information increased performance of individuals generating ideas on computers. This finding is consistent with prior results demonstrating that information about the performance of others can increase performance of groups. (p. 11)

More recent reports indicated that individual accountability provided by computer-based interaction also had a positive impact on creative output (Paulus et al., 1996).

There is a great deal of research to indicate that randomness and chance are key factors in creative thought (Campbell, 1960; Hogarth, 1980, as cited in Amabile et al., 1996, Simonton, 1999) Rothenberg (1986; Sobel & Rothenberg, 1980, as cited in Simonton, 1999, p. 313). reports on " ...experiments showing how exposure to the ambiguous juxtapositions of incongruous images stimulated artists to produce drawings that scored higher on creativity." Simonton (1999, pp. 312-313) concurs with Rothenberg's (1986) findings then summarizes the discussion stating simply, "The best creativity tends to be serendipitous rather than deliberate."

Software engineers have exploited these concepts of *ambiguous juxtapositions of incongruous images* and *serendipitous* combinations to create a variety of creativity bolstering idea generators for the commercial market. IdeaFisher (from Fisher Idea Systems Inc.) is representative of software that facilitates random associations to stimulate creativity. Drawing from a

common database, ideas are randomized then made available to the user in a manner that optimizes free association techniques. A more structured environment for fostering ideation is provided by Idea Generator (from Experience in Software Inc.). This software requires careful analysis of the problem to be addressed. Then through a series of questions forces the user to examine the issue from a variety of different perspectives. (Thierauf, 1999)

Multimedia and Creativity

According to Amabile (1996),

> The evidence suggests that much can be done to enhance and maintain creativity by establishing stimulating, supportive, and positively challenging environments. (p. 262),

Creativity flourishes in suitable environments and the strength of multimedia is its capacity to create environments. With point click interfaces environments can be altered instantaneously. Guided or random selections can create controlled or serendipitous associations of sound, text or visual effects. With automated playback, surround sound and 360 degree projection equipment a virtual world of three dimensional

stimuli can be created to accommodate every human sense and any credible creativity enhancement technique. Programmed stimuli via multimedia can create an ambient background environment to support or interact with any non-technical activity found to stimulate creative thought.

While such aggressive multimedia programs are hard to find the technology is available and in some organizations already installed. The SmartSystem Information Delivery Solution (by Dukane Corporation) linked the media center to 90 classrooms and various common areas at Dublin Scioto High School, Dublin, Ohio. T H E Journal (1998) reported that:

> 16 VCRs, four SVGA-quality VCRs, four CD-i/CD interactive players, four still video floppy players, six Laserdisc players, two C & KU band satellite receivers, one DSS/Digital Satellite, six demodulators, and two character generators used for the scrolling announcements and lunch menu. (Vol. 25)

were available to teachers. Instructors at Dublin Scioto High School were able alter their classroom environment with the touch of a button on their hand-held remote. The

creative impact of multimedia had a pronounced affect on teachers. T H E Journal (1998) noted:

> One of the biggest surprises and delights for school officials was the outpouring of creative spirit and innovative instruction unleashed by the school's centralized learning resources. (Vol. 25)

Manipulating the corporate environment through multimedia provides almost limitless opportunity for creativity enhancement. Even more intriguing is the ability of multimedia to individualize the creative environment. There are three components of creativity that when considered separately, according to one model, yields the greatest potential for creativity enhancement. Amabile (1996, p. 260) asserts that an individuals creative fingerprint is controlled by their " domain-relevant skills", their "creativity-relevant processes", and their "intrinsic task motivation." Where these three components intersect an individual will experience their greatest creativity. With databases filled with information relevant to each component, individuals can access their own creativity profile. With their creativity profile linked to an interactive

multimedia interface users would be able to tackle creative challenges, in suitable environments using techniques that optimize their unique combination of creative strengths.

CHAPTER THREE

METHODOLOGY

Introduction

Data regarding the influence of multimedia on individual creativity was gathered by conducting a study using Digital Collage multimedia software and volunteers using structured self-reporting techniques. Six individuals agreed to participate as the subjects of the study and were asked to engage in creative tasks, under controlled conditions. Their assignment was to evaluate their performances to see if the viewing of the Digital Collage enhanced their creativity. A description of the software, a brief description of the participants, an overview of the procedures, the method of data collection and a description of analytical process are given below.

Description of the Software

Digital Collage was designed to inspire the creative use of multimedia in cross-curricular planning at the high school level. It is a composite of several computer programs providing a snapshot of possible multimedia application in six different academic disciplines. The main menu, pictured in figure 1, provides the user with

push button navigation to sample programs in geography, art, science, English, history, and math. Three different multimedia programs are showcased in the six academic categories.

Figure 1. Digital Collage

The use of PowerPoint is demonstrated in the geography and science sections. The two geography slides below show PowerPoint's capacity to animate and to interface with drawing and imaging software such as Adobe Illustrator and Adobe PhotoShop. All the non-text images seen in figure 2 were done in PhotoShop.

Student use of PowerPoint is demonstrated in the science section. The project chosen for display was an assignment given in San Jacinto High School's multimedia class. It is interesting to note that the student who completed it was not a good science student. However, the opportunity to submit his report in a multimedia format motivated him to do an exceptional job. The slides in figure 3 are an example of his work.

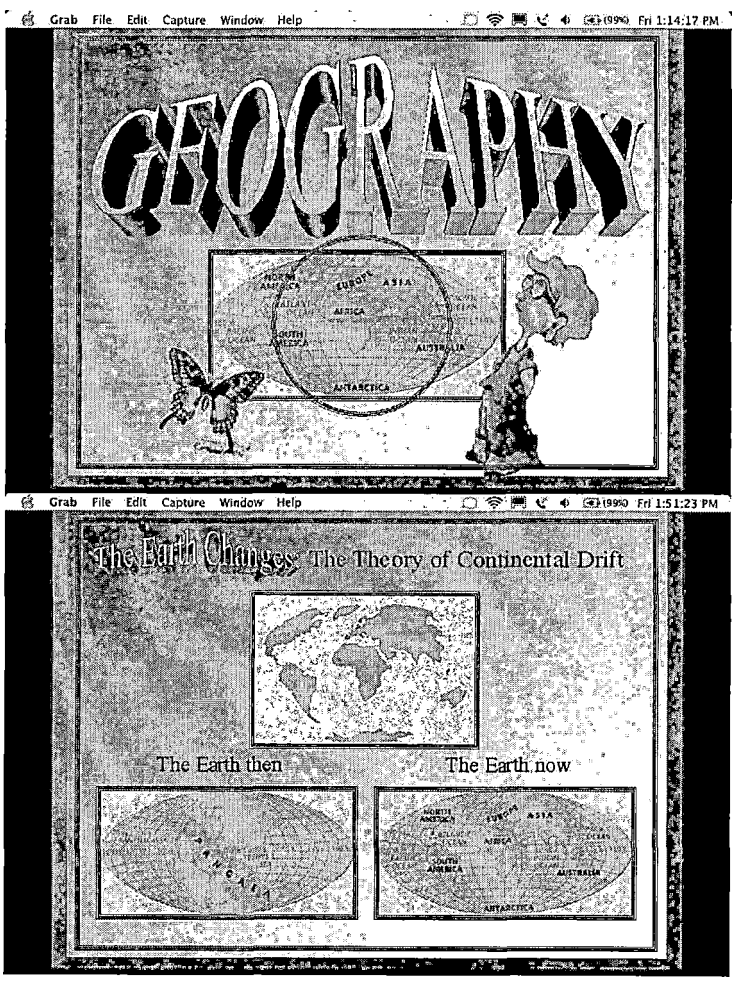


Figure 2. Geography

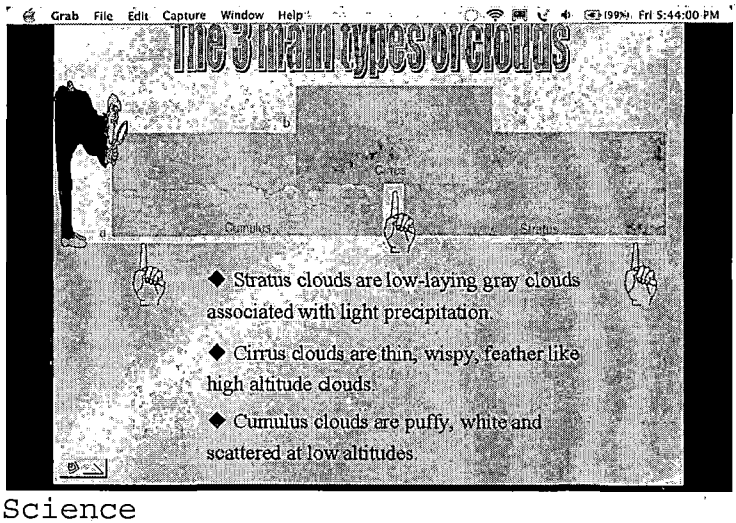


Figure 3. Science

Macromedia's Director 7 is used in the art, and math sections of Digital Collage. To appeal to the art department it was necessary to focus on both aesthetics and functionality. An art gallery designed with striking images set in an aesthetically pleasing interface was created for the demo program. Director 7 was used because it is a highly effective application for interactive programming. The interface screen shown below allows the user unlimited navigation between the sample galleries.

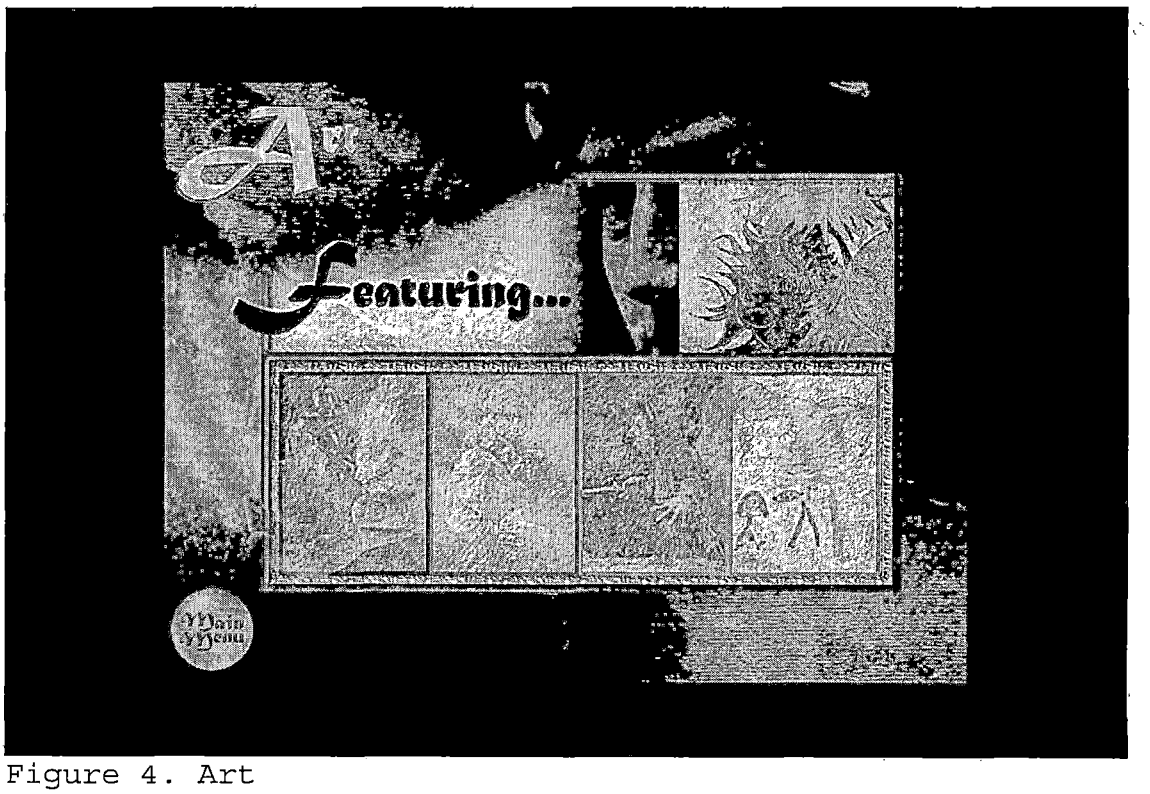


Figure 4. Art

Each of the four panels seen in the center of the screen represents a different artist who is identified when the mouse is rolled over the picture. When the picture is clicked on, the program takes the user to the artist's gallery. The galleries all contain thumbnail sized images that enlarge for closer viewing when they are clicked on. The first of the four galleries, shown below, allows the user to view a video of the artist at work. The next two galleries provide links to the artist's website.

Figure 5. Art: Kyle Still

Director 7's capacity for animation as well as interactivity made it an ideal application for designing Digital Collage's math tutorial. It was the author's goal to transition from concrete shapes to the abstract concepts used in the creation of fractions. The title page, in figure 6, labeled "Shapes & Symbols" is intended to set the stage for this transition. The connection between shapes and symbols is made, not only in the title, but also in the brightly colored, three-dimensional graphics.

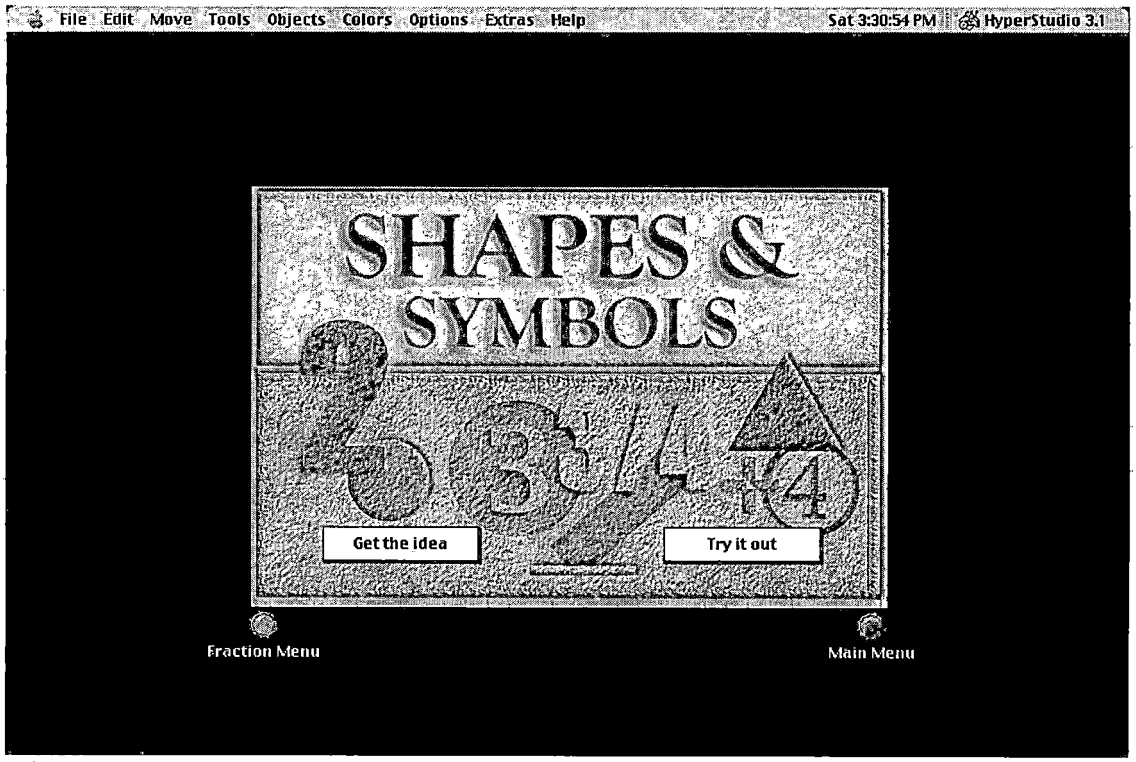


Figure 6. Math: Shapes and Symbols

A button marked "Get the idea" takes the user from the title page to the first page of the tutorial. In the audio portion of the tutorial the user meets Rufus, the denominator and Mel the numerator. Through explanation and animation the user is introduced to the denominator as the "cutter" and the numerator as the "keeper." The abstract concept of denominator is linked to the very concrete idea of a cutter of shapes. In the same fashion the numerator is linked to the concrete by being the keeper of that which is cut. Figure 7 shows the "cutter" and the "keeper" building the fraction 3/4.

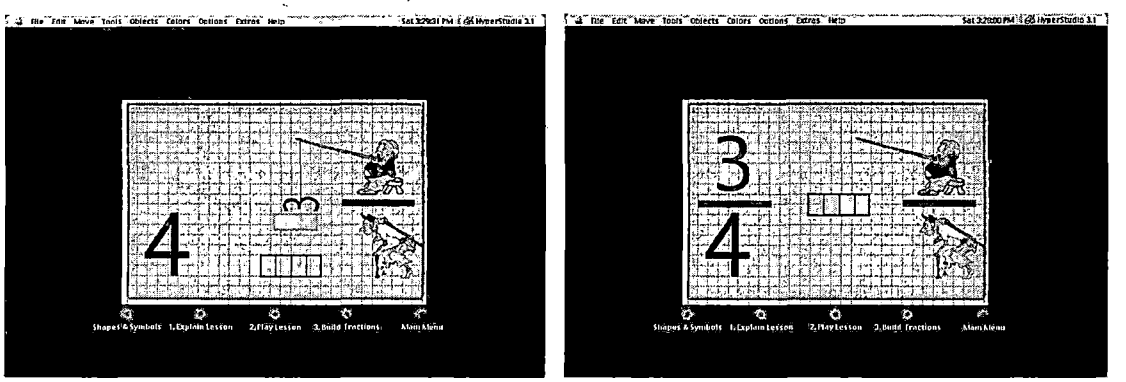


Figure 7. Math: Cutter and Keeper

Once the concepts have been illustrated to the user's satisfaction, he is given the option of building his own fraction. Clicking on the appropriate button takes him to an animated title page marked "Fraction Builders, Inc.," seen below in figure 8. The "Fraction Builders..." page is intended to separate the user from the tutorial giving him a sense of independence as well as holding his interest though animation and graphics.

From there the user goes to the interactive page seen in figure 9. On this page he can set the values of both the numerator and the denominator for a fraction in any combination between 1 and 5. Once he has selected the values for the fraction, he clicks on the "Fraction Action" button and watches denominator, Rufus, and numerator, Mel, build his chosen fraction. As the fraction builds the concepts of "cutter" and "keeper" as

well as the transition from concrete to abstract is reinforced.

Figure 8. Math: Fraction Builders Inc.

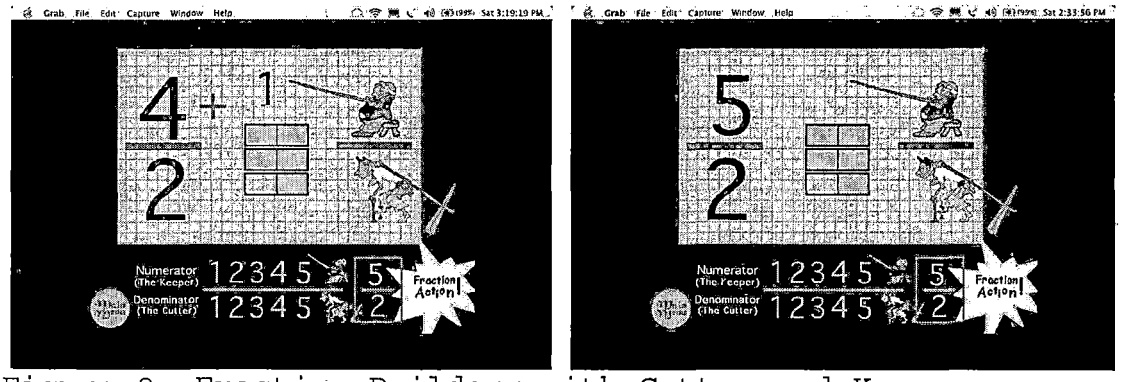
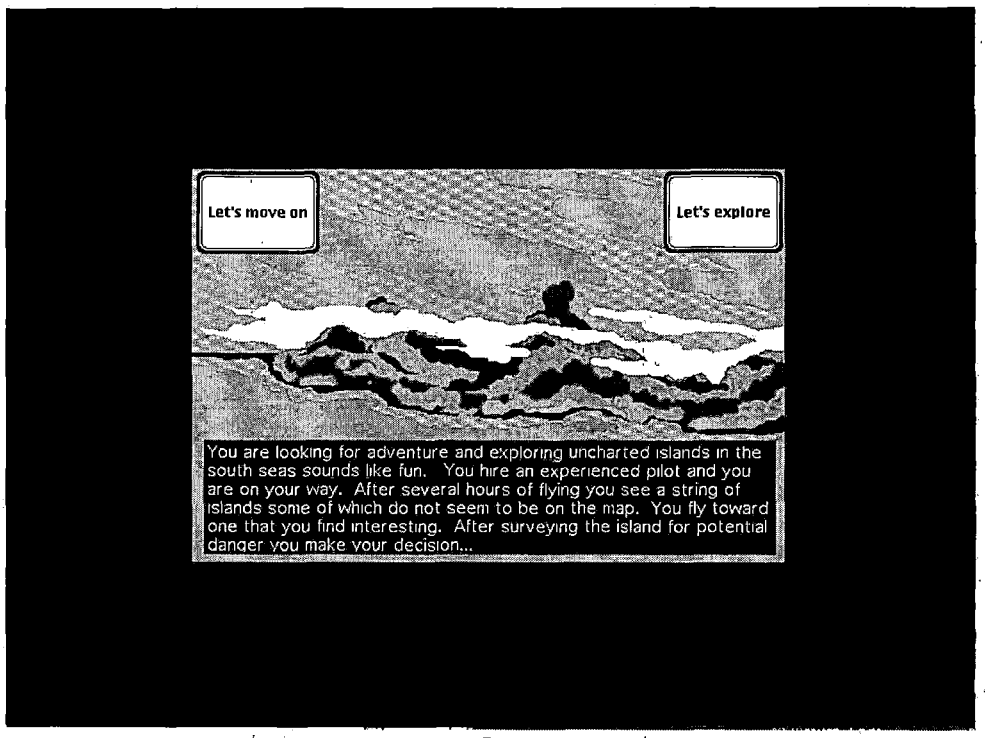


Figure 9. Fraction Builders with Cutter and Keeper

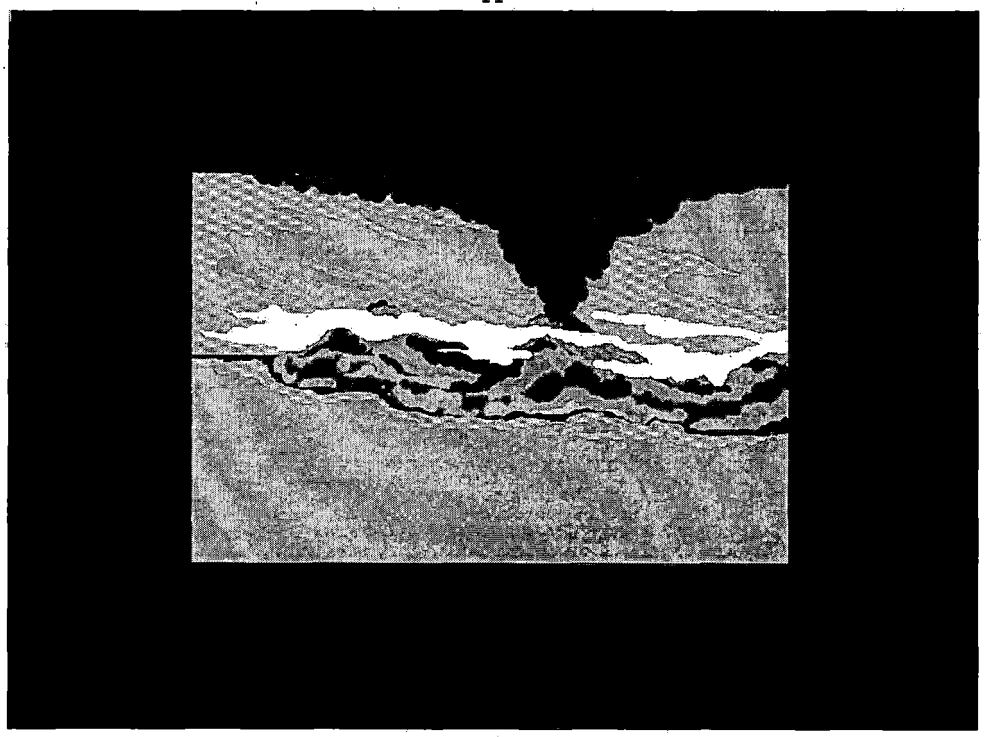
HyperStudio was the application of choice for the main user interface, and for the English and history portions of the program. HyperStudio was chosen because of its popularity in the education community and its ability to smoothly interact a large number of other authoring programs. It is simple enough that students of all ages can be trained to use it, and sophisticated enough to allow nearly unlimited design options.

The English section of Digital Collage, though still in the rough draft stage, displays HyperStudio's internal versatility. All of the design work; including text, graphics, and animation was done within the program. Nothing was imported from other applications to create "Survival", a logic-based adventure game intended to challenge high functioning junior high and high school English students.

Interactivity, dialog, logical thinking and creative writing occupy the users as they find themselves faced with several critical choices in their efforts to avoid peril on an uncharted south sea island. The first screen, in figure 10A, introduces the story line and presents the first critical decision. Poor observation or faulty logic leads to destruction by an active volcano as seen in figure 10B.



A



B

Figure 10. English—Survival

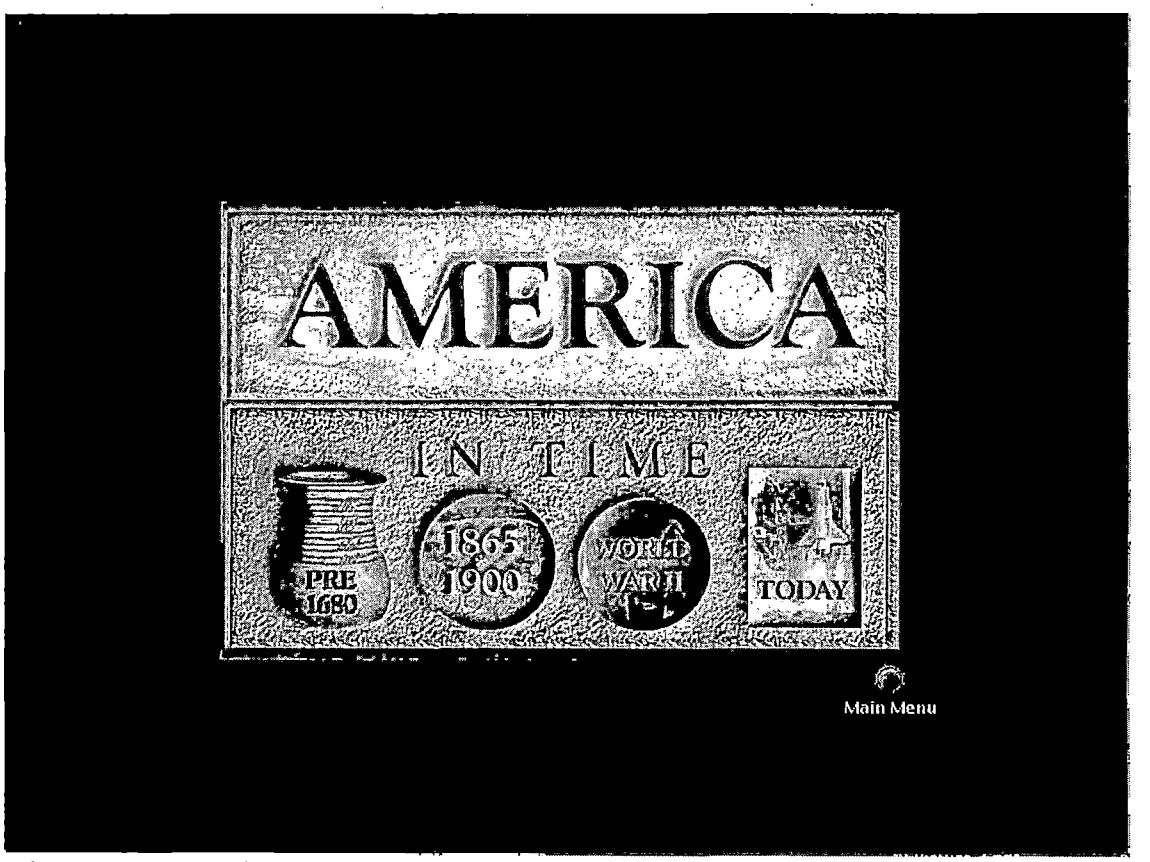


Figure 11. History

Seen in figure 11, the history screen is really nothing more than a teaser, showing HyperStudio's capacity for vivid graphics and the potential to travel graphically back in time. Instead of transporting the user to an era inscribed on each button, it takes him to a comment page where he can submit ideas, critiques and suggestions of his own.

Because the author's goal was to inspire creativity rather than present a finished product; teasers, partially completed applications, and limited demos were

preferred over a single highly developed program. It was assumed that the need for resolution would drive the user to use their own creativity.

Participants

The participants, referred to in the context of the study as subjects, were recruited using convenient sampling from a pool of colleagues, family members and their acquaintances. The author contacted them at their homes or through their work places. Four were females, ages 24, 19, 17 and 15. Two were males ages 38 and 28. One of the subjects was visually impaired. There were three students, two of them in high school and one in college, an elementary school teacher, a free-lance illustrator and a community relations representative. Only five of the original six subjects were able to complete the entire study. The visually impaired college studenthad to leave after session 2. Her quantitative scores are not included the results reported in chapter four. However, her qualitative comments were retained for discussion purposes. Race, national origin, economic level and sexual orientation were not considerations in this study.

Study Overview

In preparation for the study the subjects were asked to select two tasks each of which required creativity and more than an hour to complete. An evening was selected to conduct the study that was designed to last for two-and-a-half hours. The study was divided into five thirty minute periods—four work sessions and an overall evaluation period. For convenience the work sessions were identified as session 1, 2, 3, and 4. The study was conducted sequentially beginning with session 1, followed by sessions 2 through 4 and concluding with the overall evaluation survey.

The subjects spent an hour focused on each task. The hour was broken into two-half-hour sessions—one session with multimedia stimulus and one session without. The subjects were asked to document their creativity and worksheets were provided for that purpose. There were no limitations on how they were to record their thoughts and ideas. Their supply of worksheets was unlimited and space was provided for both words and pictures.

The last five minutes of each session was dedicated to evaluation. The subjects were giving evaluation sheets with space for both quantitative and qualitative

evaluations. They were asked first to comment on the session then to score the session on two ten-point scales, ten being highest. One scale measured their perceived level of creativity and the other measured their progress toward completing their task.

After the four work sessions were completed, the final evaluation period began. Each subject completed a six-question evaluation survey and was given the chance to ask questions or discuss any aspect of the study that captured their interest. By the conclusion of the evening, each subject had completed a set of documents that included four sets of session worksheets, four sets session evaluation sheets, and the evaluation survey.

The actual documents read at the start of each session are available for review in appendix B. A tabulation of individual session responses and survey results can be found in appendices C and D.

Data Collection and Reliability

To establish data reliability, the subjects were all asked to assess own creativity levels. This decision was based on the presupposition that creativity can be felt and that everyone has the innate ability to evaluate the

ebb and flow or their own creativity. In the evaluation at the end of each work session, subjects were to write qualitative comments and rate the sessions on two quantitative scales. The quantitative scores allowed for comparison of perceived creativity and progress from session to session. The qualitative comments provided rational for the scores and insight into factors that may have enhanced or inhibited the subjects creative performance.

For purposes of control each of the four work sessions were structured around the same basic format. With minor exceptions the instructions regarding creativity, group interaction, and documentation were identical. The only intended differences between sessions were the tasks each subject engaged in and the inclusion or exclusion of multimedia.

The subject were asked to select their own tasks because research suggests that motivation significantly impacts creativity, and that intrinsic motivation for the activities would be maximized if the tasks were selected by the subjects themselves. Since each subject came prepared with two different tasks to work on, it was decided that they would work on their first task during

sessions 1 and 2 and the second task during sessions 3 and 4. For the first task it was decided session 1 would be without multimedia and session 2 would include multimedia. For the second task the order would be reversed, session 3 would include multimedia and session 4 would be without. The order of multimedia use was switched to minimize its effect on the data. It was felt that creativity may be harder to generate during the initial stage of a new project than in the later stages. So for purposes or equity, the initial stage of task number one was performed without multimedia and the initial stage of task number was performed with multimedia.

In order to document their creative experiences and increase the potential for finding commonality, the subjects were require to describe and categorize the tasks they were engaged in for each session. For each session they were instructed to filled out their worksheet as follows:

> In the space marked "Area of Focus" provide a general category such as "lesson plan", "organization", "procedures", "school project", etc. then briefly describe the problem in the

space provided. Document as many solutions or progress toward a solution as you can. (see appendix B)

In session 1 there was very little instruction regarding creativity for fear that the instruction itself may be an inhibiting factor. It was desirable that the subjects felt free to exercise their own creative styles. The instructions mentioned only that group interaction was permissible though not required. With the introduction of multimedia in session 2 more detailed instructions relating to creativity was included.

There was concern that the information content of the software may inhibit creativity. There is evidence to suggest that symbol recognition, decoding and information processing are separate cognitive functions and may compete with the creative process. Therefore it was desirable for the subjects not to attempt to read or comprehend the multimedia material. To avoid this potential problem the subjects were encouraged to "think in terms of patterns, systems and associations that might applied, adapted or transformed to fit the problem" (see appendix B, Inspiration Test Session Scripts, Session 2). This same statement was repeated throughout the three

remaining work sessions. To further minimize the danger of being captured by the information content, the multimedia software was rapidly played through in its entirety—allowing enough time to provide impressions but not enough time to access the information. After the initial play-through, the subjects were allowed to request playback of any section of the media that sparked their interest.

Data Analysis

At the conclusion of the study session the documents were collected and prepared for analysis. The first step in the analysis was to tabulate the quantitative data. Eleven separate tabulations were made. The first tabulation entitled "Totals by Category and Session" compared the total scores for each session in three categories: creativity, progress and effectiveness. The "effectiveness" category provided a composite score from the "creativity" and "progress" categories and was added to nine of the eleven tables. The second tabulation used the same categories and compared the total scores in the sessions where Digital Collage was used with sessions where Digital Collage was not used. The next three tables

compared each subjects score in Digital Collage verses non-Digital Collage sessions for each of the three categories. The final six tables gave the individuals scores for each subject organized by category and session number. For ease of comparison each table was illustrated by a corresponding bar graph. The second step in the analysis was to organize the qualitative comments by subject and session number and correlate them with their corresponding quantitative creativity and progress scores. The chart that was created for that purpose can be seen in appendix C. The third step was to consolidate all the subjects' evaluation survey responses into one document to facilitate the comparative analysis.

Once all the data had been tabulated, graphed, categorized and consolidated the analytic process began. Attention was first directed to the overall quantitative scores, comparing the multimedia sessions with the non-multimedia sessions to see if there was a measurable difference. The various categories were then examined for emergent patterns, similarities, and identifiable trends. Individual responses were examined for their impact on the overall scores and for significant similarities or differences among the subjects. After careful examination

of the quantitative data, scrutiny was turned to the qualitative comments and the survey responses. Verbal support was sought for potential patterns that were revealed during the quantitative analysis. Attention was given to expressed attitudes that may conflict with, support or define corresponding numerical scores. Special interest was given to any comment hinting at factors effecting creativity or progress. Comments relating to individual preferences and creative styles were especially noteworthy. Anomalies, both quantitative and qualitative were carefully examined under the assumption that finding the cause of the anomaly could yield potentially valuabel information. Finally the nature of the individual tasks chosen for the study were considered to see if similar tasks corresponded to a similarity in individual responses.

CHAPTER FOUR

FINDING AND DISCUSSIONS

Introduction

Chapter four is primarily concerned with discussing the results of the study described in chapter three. However, to place the discussion in its proper context it is important to provide a description of the problems each of subjects addressed to facilitate greater insight into the findings.

Subjects and Their Tasks

Subject 1 was a 38 year-old male, elementary school teacher. In sessions one and two his area of focus was: "student discipline." His stated task was: "We have a new population of students starting our school for the first time after recently moving to the area. They need to "buy in" to our school [and] my class procedures with no prior relationship with me or our school history." In sessions three and four his area of focus was: "math pacing [and] textbooks." His stated task was: "To try to complete important areas of math text before CAT-6 test without skipping standards." Both tasks can be categorized under the heading of "organizational conflicts."

Subject 2 was a 24 year-old female, community relations representative. In sessions one and two her area of focus was: "work relations." Her stated task was: "[I am] torn between 5 bosses at work. How do I divide time, loyalties, and problem solving issues, etc." In sessions three and four her area of focus was: "personality clashes." Her stated task was: "[An] individual I work with seeks to sabotage me and make me look bad to my boss." Both tasks can be categorized under the heading of "interpersonal conflicts."

Subject 3 was a 15 year-old female, high school sophomore. In sessions one and two her area of focus was: "sculpture." Her stated task was: "Making a clay caterpillar and turning it into a hose nozzle." In sessions three and four her area of focus was: "personality clashes." Her stated task was: "[A] Christmas present for Kyle. Figure out a present Kyle would like...." Both tasks can be categorized under the heading of "artistic conflicts."

Subject 4 was a 17 year-old female, high school senior. In sessions one and two her area of focus was: "career." Her stated task was: "My problem is what do I do, career wise, with my education—both high school and

future college." In sessions three and four her area of focus was: "getting a car." Her stated task was: "I need to figure out how to get a car, pay for it, keep it running, etc." Both tasks can be categorized under the heading of "personal conflicts."

Subject 5 was a 28 year-old male, free-lance illustrator. In sessions one and two his area of focus was: "character development." His stated task was: "Develop some type of forest creature based on the natural environment of the forest." In sessions three and four his area of focus was: "background development." His stated task was: "Create inventor's (Hermit's) shack." Both tasks can be categorized under the heading of "artistic conflicts."

Subject 6 was a 19 year-old female, college student. In sessions one and two her area of focus was: "transportation." Her stated task was: " I need to transportation to go places since I do not drive." This task can be categorized under the heading of "personal conflict." In sessions three and four she was not present.

Study Results

Quantitative Results

The initial results of the study, described in chapter three, seem to indicate that creativity can be enhanced by multimedia. The subjects of the study scored themselves in three areas: creativity, progress-toward-goal, and overall effectiveness. In all three areas the scores were higher when Digital Collage was used. Five subjects were present for the entire study. By combining the ten point scales used in their individual surveys, they gave the sessions, where Digital Collage was used, a combined total of 58 creativity points and 48 progress points. In sessions where Digital Collage was not used the scores were 41 and 45 points respectively. When total effectiveness is compared, by combining the creativity and progress points, Digital Collage was favored by a score of 106 to 86. These numbers are reflected in table 1 with its corresponding graph. When the total scores of the individual sessions are compared, sessions two and three ranked higher in creativity using Digital Collage than sessions one and four, where Digital Collage was not used. However, as the graph in table 2 illustrates, progress and effectiveness

increased in sequence from session one to session four. With progress score of 34 and effectiveness score of 61, session four appeared to be the most productive session. Session three was second with scores of 30 and 59 respectively, followed by session two with scores of 18 and 47 and session one with scores of 11 and 25.

Table 2. Totals: Digital Collage versus No Digital Collage

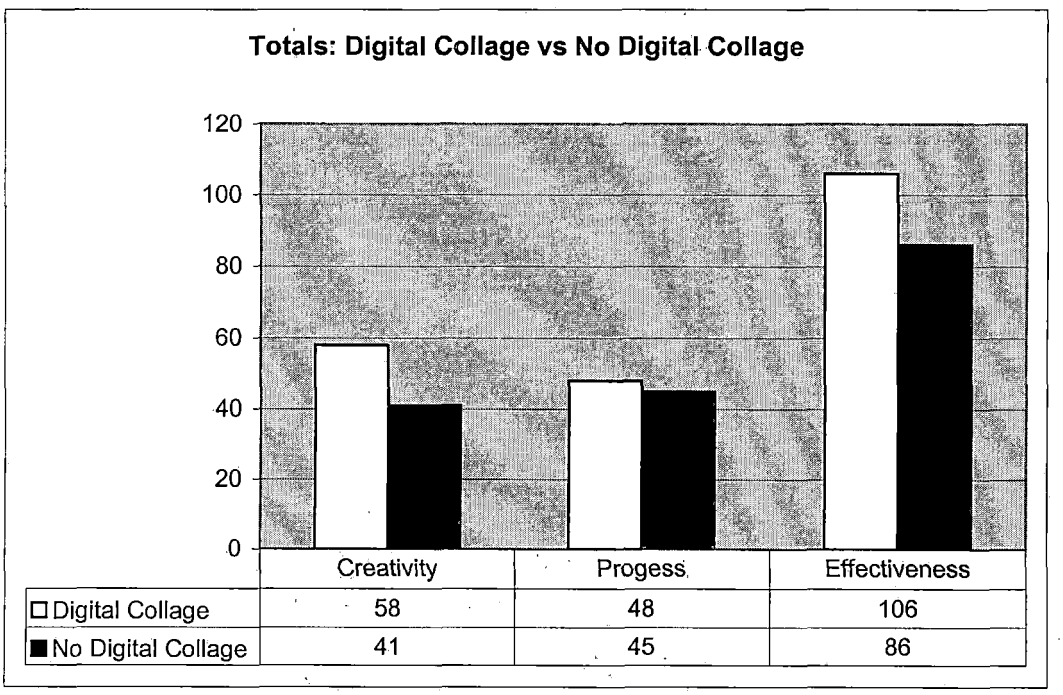
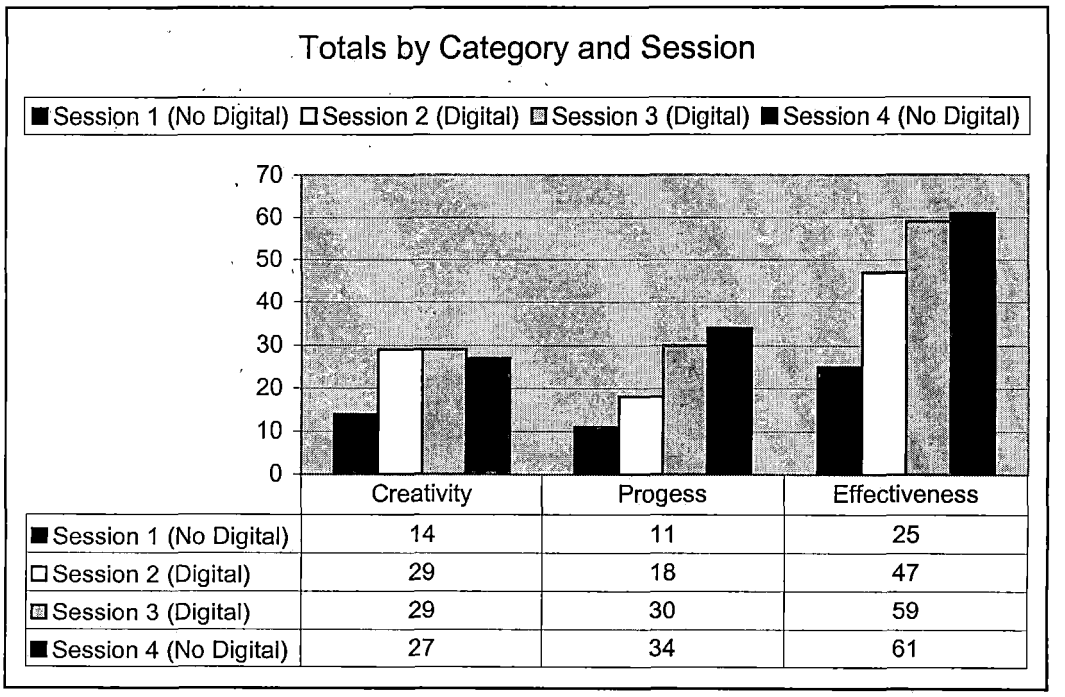


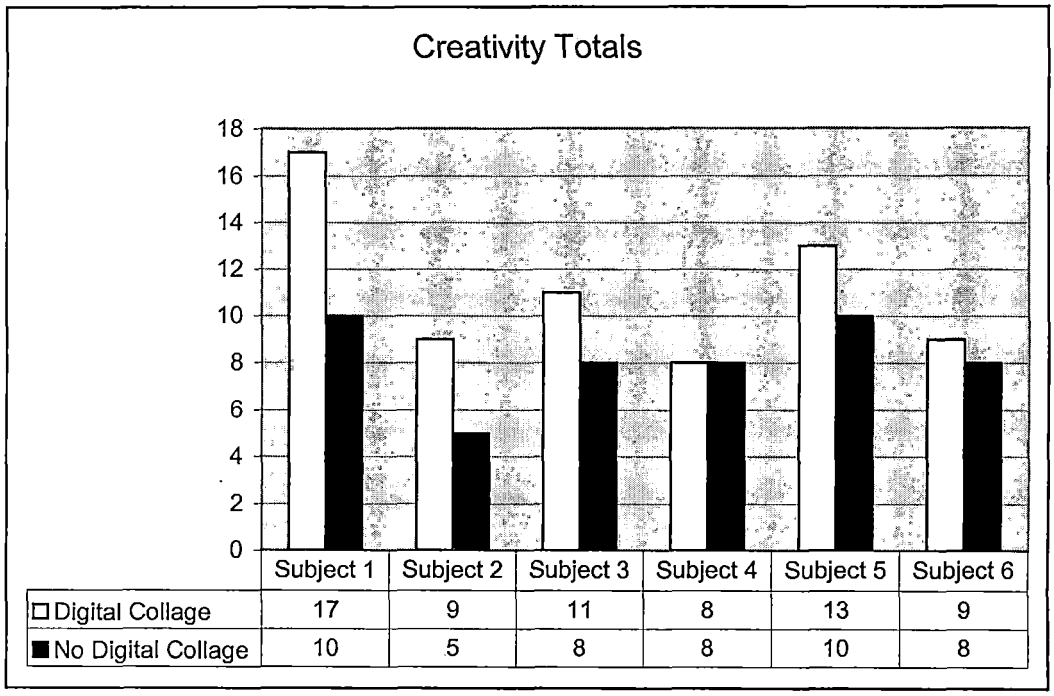
Table 3. Totals by Category and Session



	Creativity	Progess	Effectiveness
Session 1 (No Digital)	14	11	25
Session 2 (Digital)	29	18	47
Session 3 (Digital)	29	30	59
Session 4 (No Digital)	27	34	61

The individual totals in the creativity category reflected a preference for sessions using Digital Collage by five of the six subjects. Subject number 4 did not register increased creativity during sessions with Digital Collage. In fact subject number 4 was the only subject whose overall rankings showed no preference for Digital Collage in any category.

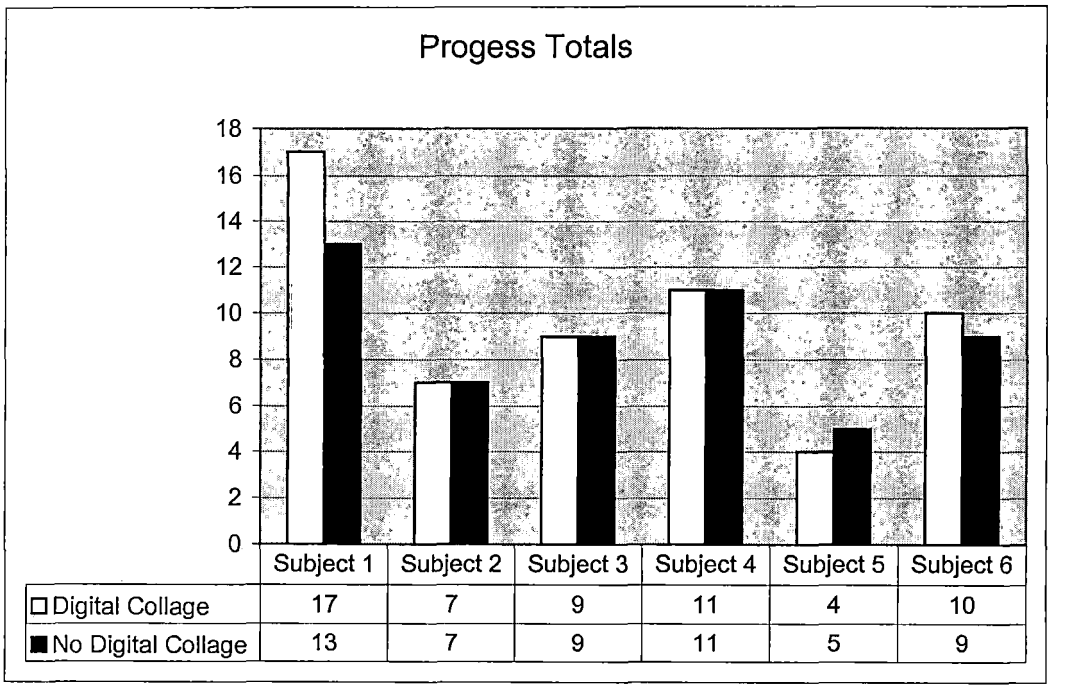
Table 4. Creativity Totals



	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6
Digital Collage	17	9	11	8	13	9
No Digital Collage	10	5	8	8	10	8

Even though the progress category showed overall scores that favored sessions using Digital Collage, the difference between was minimal. As table 4 demonstrates, three subjects showed no difference. One subject favored non-Digital Collage sessions. Two subjects preferred Digital Collage.

Table 5. Progress Totals

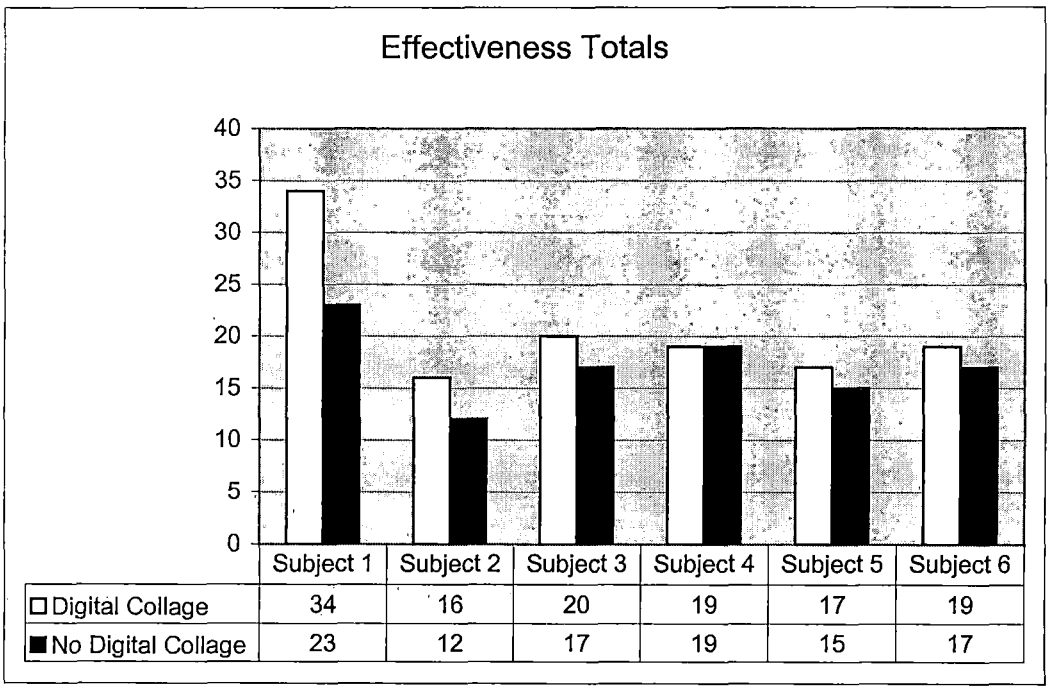


	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6
□Digital Collage	17	7	9	11	4	10
■No Digital Collage	13	7	9	11	5	9

Like the creativity totals, the totals for effectiveness showed five of out six subjects ranking sessions using Digital Collage higher than sessions without Digital Collage. Subject number four was again the only one who showed no quantitative increase under the influence of multimedia. The overall individual scores for effectiveness can be seen below in table 5.

For tables and graphs of each subject's rankings, organized by session and category, refer to appendix A. For charts of individual scores and comments organized by session refer to appendix C.

Table 6. Effectiveness Totals



Qualitative Results

In their qualitative evaluations, all five subjects who completed the culminating survey, including subject number four who showed no overall quantitative increase, indicated that Digital Collage did indeed increase their creativity. The culminating survey, complete with questions and answers is available for review in appendix D. The sixth subject, who left prior to the survey, also cited Digital Collage as the creative inspiration behind an idea she experienced during session two.

The qualitative evaluations provided valuable information to help interpret some of the quantitative assessments. Session four, for example, was ranked very high in both creativity and productivity giving it the highest score for effectiveness of all the sessions. All the subjects except subject number five gave session four the highest marks for effectiveness. However, evaluative statements following the forth session indicate that all but one of the subjects experienced residual effects from session three or earlier. Subject number one said, "It seemed like I had so much more time on this one. My brain was *already* exploring creative solutions...The creativity didn't drop off like I thought it would." Subject number three stated simply, "I mostly detailed some of my ideas from before." And subject five reiterated that she, "...Felt stimulated by last session [and] was anxious to draw ideas." Even subject four who said, "I work best when digital *collage isn't running in the background,*" implied a residual effect from previous sessions, by adding "this session being the last, my creative juices were up."

All of the subjects made statements indicating that their creativity had been enhanced by Digital Collage at

some point during the observation. Subject number 4, who earlier said that she worked better without Digital Collage, cited session two as her second most creative session. "In session 2," she stated, "the Digital Collage helped because it led my thinking toward career specifics. I wasn't very organized, but I thought of a lot of little ideas." Subject three said that Digital Collage had "sparked" her ideas. Subject five said that with Digital Collage he "...was able to see images before attempting to design [the] idea..." He said that the software gave him a "...Greater variety of thoughts to draw from while designing." Subjects one, three and five had all indicated that their creativity in session four had been a carry-over from the previous Digital Collage sessions. Following the third session, subject number two was very specific as to how Digital Collage enhanced her creativity, saying, "I found the weather section [of Digital Collage] to be very helpful. I didn't realize how many ideas came from that until I saw how many ideas were "weather" related...warm, cold, umbrella, etc." It is interesting to note subject number two was working on a relationship problem with a co-worker-it had nothing to do with weather.

Factors Effecting Creativity

Several of the subjects were very specific as to *how* Digital Collage enhanced their creativity. Subject number one noted that during session two he was better able to focus because Digital Collage initiated an attitude adjustment. He wrote, "I felt like I was better able to focus on solutions...*My attitude about the problem changed*, making solutions easier to find. Various images showed very creative ways to present familiar concepts across various subjects, getting my thinking on a more creative track." Subject number five wrote, "Many new *ideas from word associations* ...felt much more stimulated and almost overwhelmed with different directions I could go...." He noted that sound and motion also had a positive affect on his thought processes. Subject number two identified *random images* and *music* as positive aides to her thinking process.

The subjects were able to identify a number of factors they felt inhibited their creativity. The talking portions of Digital Collage—as well as harsh or abrupt sounds such as "bings" and "pops"—hindered subject number two. She was also inhibited by the pressures of limited time. Subject number five also was hindered by time

constraints. Focus and organization was particularly important to subject number four, thus anything that distracted or caused disorganized thinking frustrated her creativity. She noted that she was distracted by interruptions in media flow, such as other subjects asking for portions of Digital Collage to be replayed.

Discussion

Identifying Creativity Inhibitors

If creativity can be inhibited then it stands to reason that it can be enhanced: if not by other means, then at least by removing the inhibitors. Thus, identifying and minimizing hindrances should increase creativity. Four of the subjects identified specific creativity inhibitors.

Subject 2 noted that talking and abrupt noises, such as "bings" and "pops," within Digital Collage were distracting. Subjects 3 and 5 were hindered by environmental factors that included the presence of food, the breaking and sharpening of pencils and other people-center distractions. According to (Plsek, 1996), "focusing" is a ubiquitous characteristic among great

creators. Therefore distracting elements that interrupt focus can be expected to hinder creativity.

Lack of processing time severely impacted the creativity of subjects 2, 4, and 5. Amabile, (2003), who refers to processing time as "intellectual space", or "incubation" recognizes it as a necessary component of the creative process. Subject 4 explained why processing time is so necessary: "For me focusing and organizing are as important as creativity. If I'm really creative but not able to get my thoughts organized, all that creativity will be lost...Too much multimedia...hinders, because I'm unable to concentrate." Subject 1, on the other hand, whose creativity carried over from the previous multimedia session, found that his creativity remained high because of the increased processing time he experienced without multimedia in session 4.

Identifying Creativity Inhancers

Mental attitude plays a huge role in creativity. Subject 1 noted that he experienced a surge in creativity after his attitude changed toward the problem he was addressing. He wrote, "I felt like I was better able to focus on solutions...*My attitude about the problem changed*—making solutions easier to find." The first step

in Koberg's and Bagnall's Universal Traveler Model of the creative process (1981, as cited in Plesk 1996), "Accept the problem (as a *challenge*)," is unquestionably a reference to attitude adjustment. In the presence of a negative attitude creativity in a positive direction is severely inhibited. Creativity is enhanced when the attitude toward the problem shifts in a positive direction.

Harris, (1998), lists associative thinking as a component of creativity. All five subjects that completed the survey sited some form of associations a source for creativity. Three subjects, 1, 2 and 3, made associations from the streams of visual images. Two subjects, 4 and 5 made word associations. Subject 2 made creative associations from music. Subject 3 made associations from various shapes and figures used in the backgrounds of Digital Collage. Subject 4 made associations with objects in the room not apart from the multimedia presentation. Subject 5 noted that artistic creativity is aided by "...easily accessed information and ...having sound and motion [present] to stimulate thought." Not all associations had a positive effect on creativity. Subject 2 observed that some of the mental images and thoughts

produced by Digital Collage were unwanted associations that distracted her and hindered creativity. In every other case, when sufficient processing time was allowed, an increase in association opportunities resulted in an apparent increase in creativity.

Creativity Carryover

The five subjects, that completed the study, all reported the carry over of creativity from multimedia sessions into non-multimedia sessions. The reverse was not apparent. At first glance it seemed that no carry over creativity was reported from non-multimedia sessions into multimedia sessions. However, in citing session 4 as her most creative, subject 4 said, "*This session, being the last*, my creative juices were up." Later she explained that her creativity in the session 4 was actually an aggregate of her creativity from the previous three sessions. While the others emphasized that Digital Collage was the primary creative stimulus, none of them could rule out the possibility that their creative enhancement began in session 1 and continued to build through session 4. What all subjects made clear was that once their creativity was stimulated, it was not problem specific. Their enhanced creativity continued to operate

effectively with the second problem area as it had with the first.

Creativity and Problem Categories

To say that creativity is not problem specific does not mean that creativity is the same for every category of problem. There still could be separate types of creativity for separate categories of problem. Only problems within the same category would share the same type of creativity. This issue is raised because, though there were similarities in the subject's response to Digital Collage and the various stimuli, there were also many differences. Subject 1 seemed to be the most stimulated and experienced the fewest inhibitors. Subjects 3 and 5 were highly stimulated but also were inhibited by a number of external distractions. Subject 2 was stimulated but was also somewhat ambivalent toward Digital Collage being inhibited by elements in the program itself. Subject 4 was stimulated to the point of distraction, requiring more processing time to sustain her creativity.

It is interesting to note that the subject's response to Digital Collage roughly corresponds to the category their tasks fall into. The tasks chosen by the

five subjects fell into the following four categories of conflicts: organizational, interpersonal, artistic, and personal. These categories are significant because subjects 3 and 5 were the most similar in their response to Digital Collage and were both working on tasks from the same category. Whether such correspondence is genuine or contrived, it raises the following questions: Is creativity categorical so that different types of tasks elicit different creative responses? Or are the creative responses different because the people themselves are different—each having a different set of creative tools to work with? Hanard, (2002), acknowledges both possibilities. He notes, "... the unity/plural issue applies to creativity too...creativity may be either universal or domain-specific, with individuals exhibiting it with some kinds of problems and not with others." A detailed discussion of the subject is beyond the scope of this paper however tempting it may be to engage. Nevertheless, as a question born of the preceding research, it is worthy to mention here as a topic of future study

Creativity and Feelings

One of the fundamental postulates under girding this research is that creativity is a cognitive process that can be felt. Subjects in the controlled observation were asked to identify creativity through their feelings. Subject 1 justified this method of identification, acknowledging that his feelings corresponded to newfound creativity. He said, "I *felt* like I was better able to focus on solutions...My attitude [or *feelings*] about the problem changed...." None of the subjects registered any confusion or uncertainty when asked to measure their creativity levels for each session. Sensing ones own creativity seems as natural as feeling happy or sad. Harris (1998) sites negative attitudes as a hindrance to creativity. Amabile (2003) lists passion and intensity as components of creativity. In discussing factors that impact creativity both authors support the idea that creativity has an emotional component. Since changes in emotions can be felt, it follows that creativity can also be *felt*.

Such an argument leads to the following questions. Can feelings be used as a research tool for exploring the cognitive mysteries of creativity? Can potential

categorical changes in creativity be identified by change in the creative "feel"? Unfortunately, research limitations forbid discourse beyond the brief introduction of this topic. The issue must remain a curiosity and a subject of further research.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

Introduction

From the investigations conducted in this study five specific conclusions can be drawn and two recommendations for further research are suggested. These conclusions and recommendations are summarized in the paragraphs below.

Conclusions

Creativity Can be Enhanced

For the purpose or this study the body of research outlined in chapter two provides sufficient evidence to conclude that creativity can be enhanced.

Creativity Can be Enhanced by Multimedia Using Digital Collage

Every subject in the study noted, in their survey that Digital Collage increased their creativity. This fact was also reflected in their qualitative assessments. In quantitative assessments, sessions using Digital Collage had higher overall scores in creativity than sessions without the multimedia program.

Specific Creativity Inhibitors Can be Identified

The study identified the following as factors that can inhibit creativity:

1. Distracting elements that interrupt an individual's focus. Within Digital Collage abrupt noises ("bings", "pops", etc.) were distracting. Distracting environmental factors, external to Digital Collage, were the presence of food, people, and the breaking and sharpening of pencils.
2. The lack of time to process the flood of sensory inputs from Digital Collage choked out potential creativity.
3. A negative mental attitude toward the project curtailed creativity.
4. Unwanted mental associations produced by Digital Collage became distractions to creativity.

Specific Creativity Stimulators Can be Identified

The study identified the following as factors that can stimulate or enhance creativity:

1. A positive mental attitude toward the project stimulated creativity.

2. Random associations stimulated creativity, prompted by Digital Collage through streams of visual images, words, music, shapes, figures, sound, motion, and information.
3. Carry over creativity from prior experiences stimulated creativity in following experiences. For example, creativity generated in session three of the observation continued to stimulate creativity in session four.

Creativity is Aggregate and not Task Specific

Once creativity has been generated it will build upon itself and will not be inhibited by a change in the creative focus. If the task changes creative build up will continue uninterrupted.

Recommendations for Future Study

What is the Cause of Variations in Creativity?

In observing the effects of Digital Collage it was noted that the subjects differed in their response to the same stimuli. What was the cause of these differences is a compelling question. Two related research questions come to mind: Are the creative responses different among people because the people themselves are different—each

having a different set of creative tools to work with? Are there multiple creativity types in the same manner that there may be multiple intelligences? If research were to focus on these questions many answers and a more comprehensive understanding of creativity would result.

Can Emotion be Used as a Creativity Indicator?

The presupposition that people can identify their own level creativity has been used throughout this study. This presupposition should be thoroughly explored—not because of doubt regarding its validity, but in the hope of expanding its usefulness. The advantages of a tool that potentially can detect minor emotional shifts in the cognitive process and at the same time identify the thought content could be immensely valuable to researchers. "Can feelings be used as a research tool for exploring the cognitive mysteries of creativity—can changes in creativity be identified by change in the creative feel?" is a research question of great potential.

Summary

Chapter five reviewed the conclusions and the recommendations that have been extracted from this

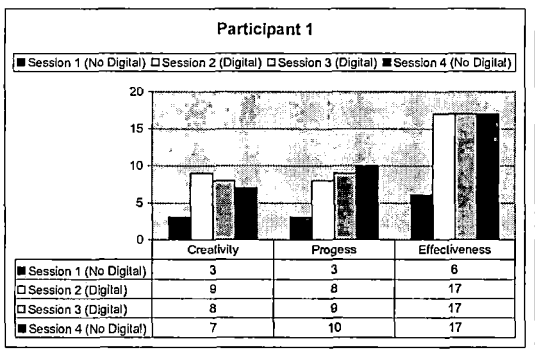
research. The purpose of this writing was to measure the ability of Digital Collage to enhance creativity and to gather some insight into creativity's nature. This was accomplished with the help of an extensive literature review found in chapter two and the study detailed in chapters three and four. However, for each insight gained many questions remain unanswered-questions that for the present remain outside the scope of this project.

Creativity is a topic of immense proportions-the smallest corner subdivides into enormity. The author hopes he has made a contribution being confident that no one could benefit from this work as much himself, nor be more aware of how much has been left undone.

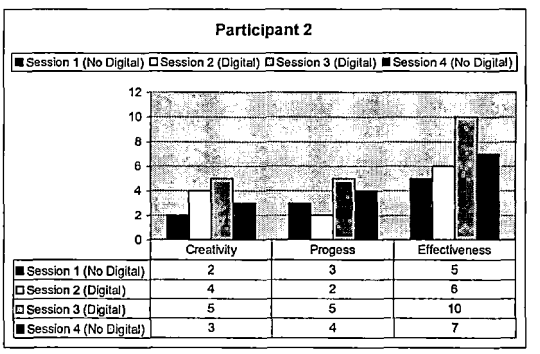
APPENDIX A

PARTICIPANT GRAPHS

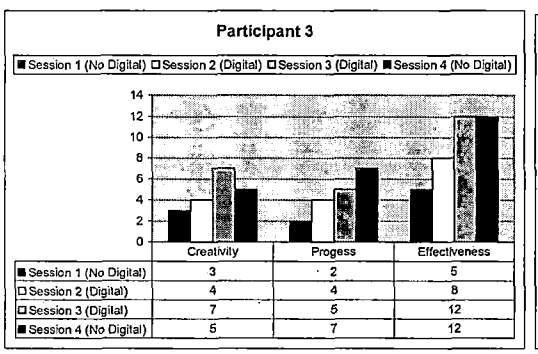
In the controlled observation discussed in chapter four, each participant scored the four work sessions for creativity and progress, on a scale of 1 to 10, 10 being highest. The combined score provided the total effectiveness score for each session. The graphs below illustrate how each participant scored the sessions.



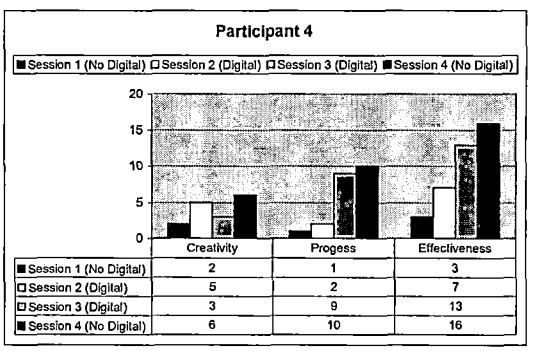
	Creativity	Progess	Effectiveness
Session 1 (No Digital)	3	3	6
Session 2 (Digital)	9	8	17
Session 3 (Digital)	8	9	17
Session 4 (No Digital)	7	10	17



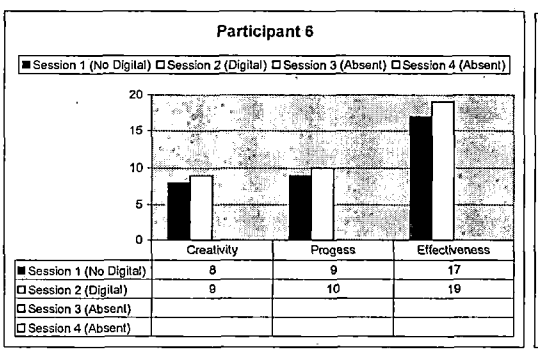
	Creativity	Progess	Effectiveness
Session 1 (No Digital)	2	3	5
Session 2 (Digital)	4	2	6
Session 3 (Digital)	5	5	10
Session 4 (No Digital)	3	4	7



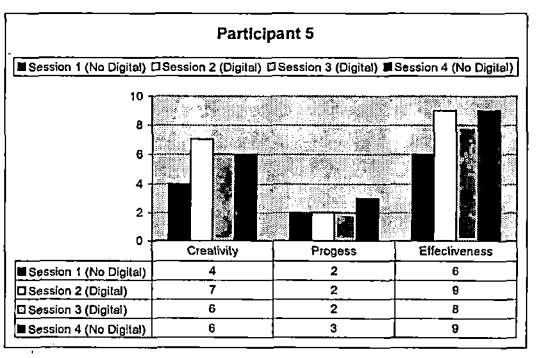
	Creativity	Progess	Effectiveness
Session 1 (No Digital)	3	2	5
Session 2 (Digital)	4	4	8
Session 3 (Digital)	7	5	12
Session 4 (No Digital)	5	7	12



	Creativity	Progess	Effectiveness
Session 1 (No Digital)	2	1	3
Session 2 (Digital)	5	2	7
Session 3 (Digital)	3	9	13
Session 4 (No Digital)	6	10	16



	Creativity	Progess	Effectiveness
Session 1 (No Digital)	8	9	17
Session 2 (Digital)	9	10	19
Session 3 (Absent)			
Session 4 (Absent)			



	Creativity	Progess	Effectiveness
Session 1 (No Digital)	4	2	6
Session 2 (Digital)	7	2	9
Session 3 (Digital)	6	2	8
Session 4 (No Digital)	6	3	9

APPENDIX B

INSTRUCTIONS AND SCRIPTS

Digital Collage: Access to Inspiration

The use of multimedia as a catalyst for creative thought

Inspiration Test Participant Instructions

You are participating in a project examining the effect of multimedia on creativity in education. The details of the project are given below:

1. You will select two topics from your own mental lists of current work-related interests or concerns that you need creative solutions for.
2. Two half-hour periods will be spent thinking about each topic. During those time periods, using the provided worksheets, you are to solve, plan, design or determine a course of action—whatever is applicable to your topic.
3. One additional half-hour session will used for summation and evaluation—five sessions in all, two-and-a-half total hours.
4. In each session other participants will be present and you are free to discuss your topic

and exchange ideas. However, interaction with others is strictly optional.

5. At the end of each half-hour topic period you are to write a qualitative comment and rate the session on two ten-point scales. One scale to measure creative thought and the other to measure progress toward achieving your goal.
6. In sessions one and four no catalyst for creativity will be provided other than what is spontaneously generated within the group or from the worksheet. In sessions two and three "Digital Collage" will used to stimulate creativity.
7. At the beginning of each session the moderator will give specific instructions as to how each session will be conducted

Inspiration Test Session Scripts

(Read by the moderator prior to each session)

Introduction:

Thank you for coming. For the next two and a half hours you will be participating in the experimental portion of a Master's project for a degree in Educational Technology from California State University at San Bernardino. The experiment will measure the effect of multimedia on creativity. The documents that you produce will become part of a body of experimental data and will published by CSUSB with the rest of the project.

Everyone should have received an information folder containing a participant release form, brief instructions, four worksheets and four evaluation sheets. The participant release form acknowledges that you are aware that you are participating in a Master's project through CSUSB and it grants permission for me to use those documents for publication. It also allows me to use you name among the list of participants in the project. Are there any questions? If there are none, please take a moment to read the form sign it, and place it back in the folder.

You have been asked to come prepared with two current work (or project) related issues that will be the focus of your creative thought. You will spend an hour focused on each issue. Each hour will be broken into two half-hour sessions—one session with multimedia stimulus and one session without. For each session you will be provided with worksheets. Please use them to record your creativity in any manner that is comfortable for you. Space has been provided for both words and pictures. You may use as many worksheets as you like. Session one is about to begin. Any questions?

Session One:

In this first half-hour session you are to consider one of your job (or project) related issues. Take out a worksheet and fill out the top portion. In the space marked "Area of Focus" provide a general category such as "lesson plan", "organization", "procedures", "school project", etc. then briefly describe the problem in the space provided. Document as many solutions or progress toward a solution as you can. Feel free to collaborate with others if you wish or work independently. After twenty-five minutes I will stop you and ask you to use

the final five minutes to complete an evaluation sheet for session one. Any questions? Please begin.

Session Two:

Please get a fresh worksheet and fill it out as before. In this second session you are to continue thinking about the same issue you addressed in session one. However, this time you will be shown a multimedia presentation. As before, think in terms of patterns, systems and associations that might applied, adapted or transformed to fit the problem. The presentation will be played through once with interruption. You are encouraged to record any ideas that occur to during the presentation. After the first showing I will replay any portion as many times as requested until the time expires. As before, feel free to collaborate with others if you wish or work independently. After twenty-five minutes I will stop you and ask you to use the final five minutes to complete an evaluation sheet for session two. Any questions? Please begin.

Session Three:

Please get a fresh worksheet and fill it out as before with two exceptions. You will change the area of

focus and the description of the problem. In this third session you are to think about a different issue than you addressed in the first two sessions. Everything else will proceed exactly as it did in session two. You will be shown a multimedia presentation. Remember to think in terms of patterns, systems and associations that might applied, adapted or transformed to fit the new problem. Again, the presentation will be played through once with interruption and you are still encouraged to record any ideas that occur to during the presentation. After the first showing I will also replay any portion as many times as requested until the time expires. As before, feel free to collaborate with others if you wish or work independently. After twenty-five minutes I will stop you and ask you to use the final five minutes to complete an evaluation sheet for session two. Any questions? Please begin.

Session Four:

Please get a fresh worksheet and fill it out as you did in session three. In this fourth session you will continue to think about the issue you addressed in session three. Use the same procedure you used in the

previous three sessions, this time without the aide of the multimedia program. Continue to think in terms of patterns, systems and associations that might applied, adapted or transformed to fit the same problem used in session three. As before, feel free to collaborate with others if you wish or work independently. After twenty-five minutes I will stop you and ask you to use the final five minutes to complete an evaluation sheet for session two. Any questions? Please begin.

Evaluation:

This is the final session. Please fill out an evaluation sheet related to you experience of the last two hours. You will be asked to complete the sentences on the form provided. There are words in parentheses, please circle the words that best fits your answer. Please be honest with your answers; do not worry about hurting anyone's feeling. Computers have no emotions. The last ten minutes will be devoted to answering questions.

APPENDIX C

INDIVIDUAL SCORES AND COMMENTS

Session 1 (No D.C.)							
Subject:	**1**	**2**	**3**	**4**	**5**	**6**	**Total**
Creativity	3	2	3	2	4	8*	14
Progress	3	3	2	1	2	9*	11

Session 1: Observation and Comments	
Subject 1	The more I try to prepare solutions—the more problems I think of. I will not be alone in this, but am being counted on by my principal to help formulate ideas and creative solutions to ease the transition of all of the "older" (4th, 5th) new students. Many of our teachers have moved schools frequently—I am still at my original school where I began teaching
Subject 2	I found I spent the whole time discovering what my problem was so that I could come up with a solution. I knew less about my problem when I went to solve it. Didn't get far. Felt like I was making bricks, so I could then build with them, instead of just building toward a solution.

Session 1: Observation and Comments (continued...)	
Subject 3	Went slow. Stuck on the same basic idea. I need to look at it from a different angle. The body looks bent.
Subject 4	The session started slowly, but at least it started. I didn't get much accomplished, but I was a little creative about what I did get done. I noticed drawing a little helped. So did the threads of plastic coming off the top of my cup, oddly enough. The threads made me think of a more specific means of research. But I'm a bit frustrated I didn't get more done.
Subject 5	Slightly distracted by those around me. However, not a bad eviroment [environment] to work in. Could have used ref. [reference] material.

Session 1: Observation and Comments (continued...)	
Subject 6	Not being able to drive is dissapointing [disappointing] because people who drive can just get up and go where they want and when they want to (depending on wether [whether] you have enough gas.) Where as, if you take a bus it is based on the bus schedule, and it doesn't take you directly to your stop.

Session 2 (D.C.)							
Subject:	**1**	**2**	**3**	**4**	**5**	**6**	**Total**
Creativity	9	4	4	5	7	9*	30
Progress	8	2	4	2	2	10*	18

Session 2: Observation and Comments	
Subject 1	I felt like I was better able to focus on solutions and that it will be great challenge and experience instead of a problem. My attitude about the problem changed—making solutions easier to find. The various images showed very creative ways to present familiar concepts accross [across] subjects, getting my thinking on a more creative track.
Subject 2	I found random images actualy [actually] did help my mind run—maybe faster, but I don't know about better. The music parts helped...the talking didn't. I found I thought more, but got a little less done. More time, I think would have helped.

Session 2: Observation and Comments (continued...)	
Subject 3	Was better this time I think. Just a little better. I made the caterpillar more curvy, but I still haven't figured out the dandle. It will probably be holding a stick, and the stick could be the handle. I like that idea best.
Subject 4	I got some ideas from the presentation, but was unable to organized my thoughts because of the time limit. I the presentation had only been played once or only I controlled it, I would have gotten more done because I wouldn't have been distracted by the other people's requests to see something over. Then again, having other people is helping me to focus because they're focusing, too. The digital collage [Digital Collage] was helpful in spurring on archaeology-related ideas, but not for organizing them. More time would have been good, too.

Session 2: Observation and Comments (continued...)	
Subject 5	Many new ideas from word assosiations [associations]. Felt much more stimulated and almost over welmed [whelmed] with different directions I could go with creature design. Would have liked to spend more time applying thoughts to design.
Subject 6	The slides gave me an idea of one way on how to find a ride. That made me a bit relieved. Now I have one idea but not enough info [information] to getting my full answer.

Session 3 (D.C.)							
Subject:	**1**	**2**	**3**	**4**	**5**	**6**	**Total**
Creativity	8	5	7	3	6		29
Progress	9	5	5	9	2		30

Session 3: Observation and Comments	
Subject 1	I was able to think of may ideas even though I felt pretty brain dead after 8 hours of inservice training today on a subject we have had several times. Some ideas were pretty creative (after looking it over again now). I think I have a pretty good start on this. The districts answer was to skip entire units - but to fit those in seems like a better way to short-cut the students.

Session 3: Observation and Comments (continued...)	
Subject 2	Came up with a lot of ideas but didn't quite get to a solution - was headed there. Found the "weather" section to be very helpful - didn't realize how many ideas came from that till I saw how many ideas were "weather" related... warm, cold, umbrella, etc. I think better with quiet or "useful" sound like music, comentary [commentary]. Sounds like "bings" & "pops" set me back.
Subject 3	I made a lot of progress. A lot of these Kyle would like. I like the skateboarder doing a trick, chess board and set with clay pieces, and the miniature diamond. Going through the program gave me a lot of ideas. The shapes of things especially. I'm going to pick one or two and draw them in detail.

Session 3: Observation and Comments (continued...)	
Subject 4	I made a good amount of progress, but still feel like there is more and I just can't think of it. I didn't get really creative, but enough so that I needed 2 sheets of paper. I hadn't previously thoughts of creating a gas allowance for each month, so I'd call that a creative idea.
Subject 5	Many ideas, a little brained though. Would have liked to focus more.

Session 4 (No D.C.)							
Subject:	**1**	**2**	**3**	**4**	**5**	**6**	**Total**
Creativity	7	3	5	6	6		27
Progress	10	4	7	10	3		34

Session 4 Observation and Comments	
Subject 1	It seemed like I had so much more time on this one. My brain was already exploring creative solutions. But a few ideas surprised me. I'm not sure if they can work, but it was nice to think about so many possibilities. The creativity didn't drop off like I thought it would, and I'm pretty worn out!
Subject 2	Had a very hard time concentrating, seemed like a lot ended up on my page, but not towards a unified goal. Disjointed. Would have rather had images to look at during lag time. Don't know.

Session 4: Observation and Comments (continued...)	
Subject 3	I mostly detailed some of my ideas from before. But it came out well. I had a little of a block making the chess pieces. Not quite as progressive as before.
Subject 4	This session went very well for me. I even found a solution for my problem. This was the most creative session for me - and very organized when compared to the others. I work best when digital collage isn't running in the background, I've noticed. This session being the last, my creative juices were up.
Subject 5	Felt stimulated by last session was anxious to draw ideas. Thought there was not enough time explore application of thoughts.

APPENDIX D

SURVEY QUESTIONS AND ANSWER

Question 1	The Digital Collage software program (did, did not) increase my creativity.						Question 1
Subject:	1	2	3	4	5	6	Total
Did	x	x	x	x	x		5
Did not							0
Question 2	The two sessions I felt the most creative in were (1,2,3,4,) because...						Question 2
Subject:	1	2	3	4	5	6	Total
Session 1		x					1
Session 2	x			x			2
Session 3	x	x	x		x		4
Session 4			x	x	x		3

Question 2 comments continued below...		
Question 2	**The two sessions I felt the most creative in were (1,2,3,4,) because...**	**Question 2**
Subject 1	...2 and 3, but the creativity from 2 and 3 carried over and I remained pretty creative during 4 as well.	
Subject 2	...I'm not sure why. Could be because it was the beginning of each. Also, was just having a non-creative day, and wore out quickly.	
Subject 3	...my problem was different and we did the digital collage first and that sparked my ideas.	
Subject 4	...In session 2, the Digital Collage helped because it led my thinking toward career specifics. I wasn't very organized, but I thought of a lot of little ideas. Session for [four] was the most creative one of all, but that was just me thinking—without help from Digital Collage.	
Subject 5	...was able to see images before attempting to design idea. Greater variety of thoughts to draw from while designing,	

Question 3	The two sessions I made the most progress in were (1,2,3,4,) because...						Question 3
Subject:	1	2	3	4	5	6	Total
Session 1							0
Session 2	x						1
Session 3	x	x	x	x	x		5
Session 4		x	x	x	x		4
Subject 1	...2 and 3, 2 gave me creative ideas to a question I was struggling with, 3 set me on a path for many unique or different ways of looking at the problem.						
Subject 2	...it was a simpler problem for me. Also, we started 3-4 with the college [collage], and it got my brain going.						
Subject 3	...different problem which the digital collage had more effect on.						

Question 3 comments continued below...							
Question 3	The two sessions I made the most progress in were (1,2,3,4,) because...						Question 3
Subject:	1	2	3	4	5	6	Total
Subject 4	...I felt extremely productive in sessions 3 and 4 because I was able to focus better and organize my thoughts well. For me, focusing and organizing are as important as creativity. If I'm really creative but not able to get my thoughts organized, all that creativity will be lost.						
Subject 5	...using the Digital Collage first was more practical than the other way around.						
Question 4	In general I think that multimedia software (does, does not) increase creativity.						Question 4
Subject:	1	2	3	4	5	6	Total
does	x		x	x	x		4
does not		x					1

Question 5	Did the Digital Collage software program influence your answer to question 4? (Yes, No).						Question 5
Subject:	1	2	3	4	5	6	Total
Yes	x		x	x	x		4
No		x					1
Subject 1	...It was unique and creative, and made me think of things in a creative, and fun light.						
Subject 2	...I already had my mind made up.						
Subject 3	...shapes and figures sparked ideas.						
Subject 4	...Multimedia, like Digital Collage helps give you ideas that spur creative thinking. Too much multimedia, though, for me, hinders, because I'm unable to concentrate.						
Subject 5	... Experienced a surge of random thoughts during Digital Collage, due to the many layers of information.						

Question 6	I think the Digital Collage software program (would, would not) be useful (for, because)...	Question 6
Subject 1	...(would) be useful (because)...students would love the look and feel of the program, teaches dwould love the addition tool for teaching—motivating learning.	
Subject 2	...(would,) be useful (for)...teaching, learning, refresher studies, as as creative thinking, writing and problem solving. Each subject and each option within the subject really did flood my mind with all kinds of mental images/thoughts. Some useful, some distracting, but out of them I came with some things I otherwise would not have.	

Question 6 comments continued below...		
Question 6	**I think the Digital Collage software program (would, would not) be useful (for, because)...**	**Question 6**
Subject 3	...(would) be useful (because)...you can look at it a lot of different ways which sparks a lot of different ideas.	
Subject 4	...(would) be useful (for) ...creativity when used with time to think and organize thoughts.	
Subject 5	...(would) be useful (for)...assisting artists in creative designs, because of the easily accessed information and the bonus of having sound and motion to stimulate thought.	

APPENDIX E

INSTITUTIONAL REVIEW BOARD APPLICATION

AND RESPONSE

February 13, 2005

INSTITUTIONAL REVIEW BOARD

CALIFORNIA STATE UNIVERSITY SAN BERNARDINO

Application to Use Human Participants in Research

DEFINITION OF "USE OF HUMAN PARTICIPANTS"

A research project involves human participants when there is an intervention or an interaction with a living person that would not be occurring, or would be occurring in some other fashion, but for this research, or when identifiable private data or information is obtained for the research that can be associated with the identity of an individual participant.

All research involving human participants must be reviewed and approved by the Institutional Review Board (IRB). Information concerning the procedures for review of such research can be obtained from the Research and Sponsored Programs Office (AD 128). In addition, assistance is available from any member of the Institutional Review Board (IRB). A listing of current members can also be obtained from the Research and Sponsored Programs Office.

PROCEDURES FOR REVIEW

Submit the completed application with the appropriate number of copies (as indicated on the application) to:

Research and Sponsored Programs (Administration Building Room AD-128).

Proposals from the Psychology and Social Work departments should be submitted to your departmental Human Subjects Review Board Subcommittee.

Proposals are normally reviewed within two weeks of submission. A letter detailing the Board's decision will be sent to the applicant (or applicant's advisor) via campus mail.

CATEGORIES OF REVIEW

There are three categories of IRB review: exempt, expedited, or full board review. In order to qualify for either exempt or expedited review, a project must also qualify for waiver of written (signed) informed consent. That is, the research must present no more than minimal risk to participants and involve no procedures for which written consent is normally required outside the research context, or the principal risk to the participant must be the potential harm that would result from breach of confidentiality because of the signature on the consent document. Consult IRB policies and procedures for more detail.

Any research involving children (age 17 or younger), or any research in which the participant is asked to sign or to provide an identifying name on any document, is not eligible for exempt or expedited review. In addition, projects involving external grant support are not eligible for exempt or expedited review.

QUESTIONS

Any questions regarding IRB policy, procedures, or applications status should be directed to:

Dr. Joseph Lovett (IRB Board Chair)
Department of Health Sciences
& Human Ecology
CSU San Bernardino
5500 University Parkway
San Bernardino, CA. 92407
Please Use Email Only: jlovett@csusb.edu
(Please use Email)
(909) 880-5393
(909) 880-7037

Michael Gillespie (IRB Secretary)
Administrative Support Coordinator I
Research & Sponsored Programs AD-128
CSU San Bernardino
5500 University Parkway
San Bernardino, CA. 92407
Email: mgillesp@csusb.edu
Phone: (909) 880-5027
Fax: (909) 880-7028

Please include your IRB ID# (if available) in all correspondence.

IRB WEBSITE: http://irb.csusb.edu

Includes:

- IRB Applications in PDF and Word format
- Sample Forms
- Research Ethics Sites
- Other items of interest

INSTITUTIONAL REVIEW BOARD

CALIFORNIA STATE UNIVERSITY SAN BERNARDINO

Application to Use Human Participants in Research

1. **PROJECT REVIEW**

x New Project (ID# will be assigned by the IRB)

☐ Revised Project (Enter IRB ID#) _____

☐ Renewal (Enter IRB ID#) _____

Approximate date of most recent **previous** review of this project _____

2. **DATA COLLECTION DATES: From** 8 / 20 / 04 **To** 8 / 23 / 04

This is required information, must be future dates - after you have received final IRB approval to conduct your research.

3. **INVESTIGATOR(S) NAME(S)** Frederick G. Still

Department Educational Technology Phone 880-5692

Student(s)/Researcher(s) E-mail Address(s): rstill@mac.com

If you are a **student**, please provide the following information:

This research is for x Graduate Thesis & Projects ☐ Honors Project

☐ Independent Study ☐ Course _____

☐ Other _____

4. **PROJECT TITLE** Digital CollageÑ Access to Inspiration:

The Use of Multimedia as a Catalyst for Creative Thought

5. **DESCRIPTION OF PARTICIPANTS** (Enter approx. no. of participants and categories that apply)

Number 6 Gender: 4 Female 2 Male

☐ CSUSB Students 2 Children (17 or younger) ☐ Child Development Center

☐ Prisoners ☐ Patients in institutions ☐ Pregnant Women

4 Others 1 Junior College student; 3 Working Professionals

6. **IS FUNDING BEING SOUGHT FOR THIS RESEARCH?**

☐ Yes x No

If yes, you must submit one complete copy of that proposal as soon as it is available and respond to the following questions:

Does the funding agency require notification of Institutional Review Board approval?

☐ Yes ☐ No

(If yes, please provide the IRB Secretary with one copy of all relevant forms, instructions, etc., with your original copy of this application.)

Project period from _____ to _____

7. **INDICATET HEREV IEWCAT EGORY FORWHICH YOU ARE APPLYING.**

☐ I am applying for **exempt review**, basedonth e following category (ies):
(Check all that apply. Sub mit anor iginal andone copyo f all appl icationm aterials to the IRB.)
Note: Researchin volvingch ildrenmus t bereviewed FULL BOARD.

- ☐ Research conduc ted in establishedo r co mmonly accepted educ ation al settings and involv ingno rmal educ ation alp ractices
- ☐ Research involv ing theu seo f educ ation al tests, if information from these sources is recorded insu cha mann er that particip ants canno t be identified in anyw ay
- ☐ Research involv ingsu rveyo r in terviewp rocedures wh erep articipants canno t be id entified
- ☐ Research involv ing theob servationo f public behav ior wh ere pa rticipan ts cannotb e iden tified
- ☐ Research involv ing the collectiono r studyo f ex istingda ta, docu ments, records, patho logical sp ecimens, ord iagnos tic sp ecimens, wh ere th ese sou rces are publicly availab le or whe re participants canno t be id entified

☐ I am applying for **expedited review**, basedonth e following category(ies):
(Check all that apply. Sub mit anor iginal and1 copyo f all application materials to the IRB.)

- ☐ Collectiono f hair, n ail clipp ings, teeth in anon -disfiguring manne r.
- ☐ Collectiono f excretal and/or ext ernal secretions.
- ☐ Recordingo f data from adults us ingnoninv asive proc edures.
- ☐ Collectiono f mode rate levelso f bloods amp les from adu lts in goodhe alth.
- ☐ Collectiono f supra- andsub -gingival den talp laque and calculu s.
- ☐ Voice record ings made for researchpu rposes.
- ☐ Mod erate exercisebyh ealthyvo lunt eers.
- ☐ Studyo f existingd ata, do cuments, records, o r patholog ical or diagno stic specimen s.
- ☐ Non-manipu lative, non-stress ful researchg roupo r ind ividua l behav ior.

x I am applying for **full boa rd review**.
(Submit an original and 1 copy of al applic ation materials to the IRB.)

8. **ATT ACHMENTS.** I have includ edcop ies of all relevantp roject materials anddo cuments, includ ing (check all that app ly):

- x Surveys, qu estionna ires, and/o r interview in strument s.
- x Informed cons ent forms or statements.
- ☐ Letters ofapp roval from coope rative agen cies, schoo ls, o r educationboa rds.
- ☐ Debriefings tatements or expl anation sh eet.

9. AFFIRMATION OF COMPLIANCE:

I agree to follow the procedures outlined in the summary description and any attachments to ensure that the rights and welfare of human participants in my project are properly protected. I understand that the study will not commence until I have received approval of these procedures from the IRB or where appropriate a department Human Participants Review Board; I have complied with any required modifications in connection with that approval. I understand that additions to or changes in the procedures involving human participants, or any problems with the rights or welfare of the human participants must be promptly reported to the IRB. I further understand that if the project continues for more than one year from the approval date, it must be re-submitted as a renewal application.

*NOTE: You (the investigator/researcher) are required to notify the IRB if any substantive changes are made in your research prospectus/protocol, if any unanticipated adverse events are experienced by subjects during your research, and when your project has ended. Important: If your project lasts longer than one year, you (the investigator/researcher) are required to notify the IRB by email (mgillesp@csusb.edu) or correspondence of *Notice of Project Ending* or *Request for Continuation* at the end of each year. Failure to notify the IRB of the above may result in disciplinary action. You are required to keep copies of the informed consent forms and data for at least three years.

*(Required for all investigators):

I affirm the accuracy of this application, and I accept responsibility for the conduct of this research, the supervision of human participants, and maintenance of informed consent documentation as required by the IRB.

	rstill@mac.com	10/18/04
Signature of Investigator	Your e-mail address	Date
Signature of Co-Investigator(s)	Your e-mail address	Date

APPROVAL OF FACULTY ADVISOR/SPONSOR

*(Required for all faculty advisors) By signing - you as faculty advisor affirm the accuracy of your students application and accept responsibility for the conduct of this research, the supervision of the researcher (student) in ethical conduct of research, and maintenance of informed consent documentation as required by the IRB.

Printed Name of Faculty Advisor/Sponsor	Campus Phone	E-mail of Faculty Advisor
Signature of Faculty Advisor/Sponsor		Date

APPROVAL OF A LICENSED PHYSICIAN (Required only if the project involves medical procedures and neither the investigator nor the faculty/advisor is a licensed physician)

Printed Name of Licensed Physician	Contact Phone
Signature of Licensed Physician	Date

Please *Re-type* the headings and answer in your own words (given below in bold face type) for questions 10 through 15 and use as many separate sheets of paper as you need to respond fully. **DO NOT COPY THESE PAGES AS PART OF THE APPLICATION.** Attach the appropriate forms as requested in 14 and 15.

10. PARTICIPANT RECRUITMENT.

As the subject of my own case study, I was both researcher and participant in this project. I am a 54 year-old middle school science and math teacher in reasonable good health. The other participants were drawn from a pool of colleagues, family members and their acquaintances. I personally contacted them at their homes or through their workplaces. Four were females, ages 24, 19, 17 and 15. Two were males ages 38 and 28. One of the participants was visually impaired. There were three students, two of them in high school and one in college, an elementary school teacher, a free-lance, illustrator and a community relations representative. Race was not a consideration in this study.

11. PROJECT DESCRIPTION.

Digital Collage is a two-fold project. It is a study of the nature and mechanics of creativity and it provides data regarding the influence of multimedia on individual creativity. Research into the nature and mechanics of creativity was conducted through self-analysis. The creative thoughts and processes that were encountered during the development of the Digital Collage software, and during the writing of the thesis, were documented and analyzed. Emotional sifts that were felt during the writing process were used as indicators of a change in the thinking environment and the corresponding thoughts were then analyzed. The research question upon which the self-analysis study focused was, "Are there different types of creativity that can be categorized according to the various factors and environments that effect them."

Data regarding the influence of multimedia on individual creativity was gathered by conducting a controlled observational study. Six participants were studied to see if the viewing of the Digital Collage software enhanced their creativity. They were asked to select two topics from their own mental lists of current work-related interests or concerns that they needed creative solutions for. Two half-hour periods were spent thinking about each topic. During those time periods, they attempted to resolve their issues. As a control, half of the time they worked without the availability of multimedia. The other half of the time they viewed Digital Collage projected onto a large screen, during the work sessions. After each half-hour session they made quantitative and qualitative evaluations. At the conclusion of the work sessions they filled out a questionnaire summarizing the experience. The data was then compiled, analyzed and summarized.

12. CONFIDENTIALITY OF DATA.

Each participant is asked to sign an informed consent document that grants permission to use their data In order to honor their right of confidentiality of data, only pseudonyms will appear in the report. No data of a compromising nature will be included in the paper. Therefore, no harm can be done to anyone who participates in this study.

13. RISKS AND BENEFITS.

There are no particular risks or benefits to the participants or society that can be reasonably expected to arise from this study.

14. INFORMED CONSENT. (See attached sample below)

Digital Collage Informed Consent Form (Adult)

The study in which you are being asked to participate in is designed to measure the effect of multimedia on creativity. This study is being conducted by Frederick G. Stillunder the supervision of Dr. Eun'Ok Baek, Professor of Educational Technology.

You are asked to come prepared with two work (or project) related issues that will be the focus of your creative thought. It will take approximately three hours to complete the study. You will spend an hour focused one ach of your two issues and approximately one hour evaluating. Each issue will be dealt with in two half-hour sessions. One session with multimedia stimulus and one session without. For each session you will be provided with forms to record and evaluate your creativity.

There are no particular risks or benefits to the participants or society that can be reasonably expected to arise from this study. Your name will not be used in any publication that results from this study. You have the right to withdraw from this project at any time without penalty. Participation in this study is strictly voluntary. By signing this form you are granting permission for Frederick G. Stillto use the data you produce during the study.

For questions regarding injuries or your rights as a participant in this study please contact Michael Gillespie (IRB secretary). Phone: 909-880-5027 email: mgillespie@csusb.edu.

The Institutional Review Board, California State University, San Bernardino, has not reviewed this study.

Name of participant (please print):_____

Signature of participant:_____ Date:_____

Digital Collage Informed Assent Form (Minor)

The study you are being asked to participate in is designed to measure the effect of multimedia on creativity. This study is being conducted by Frederick G. Stillunder the supervision of Dr. Eun Ok Baek, Professor of Educational Technology. It will take about three hours. Here is what I want you to do:

1. Pick two problems you want to solve that will each take more than an hour.
2. Two half-hour periods will be spent thinking about each problem—four periods total. During that time you are to try to solve the problem using the worksheets I give you.
3. One half-hour period will be used to summarize and evaluate your work—five periods in all including the four problem periods. Total time: two-and-a-half to three hours.
4. At the end of each half-hour period you are to write a comment and score your work on two ten-point scales. One scale to measure creative thought and the other to measure progress toward achieving your goal.
5. In sessions one and four no multimedia will be used to stimulate creativity. In sessions two and three "Digital Collage" will used to stimulate creativity.
6. At the beginning of each session the moderator will give specific instructions as to how each session will be conducted

This study not dangerous. It will neither hurt nor help you. You have the right to withdraw your data from this project at any time without penalty. Participation in this study is strictly voluntary.

By signing this form you are granting permission for Frederick G. Stillto use the data you produce during the study. Your name will not be used in any publication that results from this study.

The Institutional Review Board, California State University, San Bernardino, has not reviewed this study.

For questions regarding injuries or your rights as a participant in this study please contact Michael Gillespie (IRB secretary). Phone: 909-880-5027 email: mgillespie@csusb.edu.

Name of participant (please print):_____

Signature _____ Date:_____

I give full consent for my child, who is under 18, to participate in the program as described above. I understand what will be done to my child and that he or she is in no danger of harm.

Participants under 18_____ Date_____

Signature of parent or guardian:

Frederick G. Still

24971 Thames Court
Hemet, CA 92544

RE: Correction of misinformation

Dear [participants name],

Thank you for being part of my study of creativity. Your data was extremely helpful and I appreciate it a great deal. I am writing to correct some misinformation that was in the consent letters you received with your instructions and research documents.

First of all, the letter for under aged participants was titled incorrectly. The title read "Digital Collage Informed Consent Form (Minor)", it should have read "Digital Collage Informed Assent Form (Minor)." Secondly, both the adult and minor letters were ambiguous as to the matter of your names appearing in a publication. They will not appear. The third correction involves omitting a line in the minor's "Informed Assent Form." A line should have been added to clarify that by signing the document the parent or guardian is acknowledging that he or she understands what will be done to their child. This omission has been corrected. Finally, I was under the impression that the Institutional Review Board (IRB) had reviewed the study procedures. They had not, nor will they. This correction has also been made in the documents.

Enclosed you will find a copy of the corrected letters.

Yours truly,
Frederick G. Still
Enclosure (2)

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